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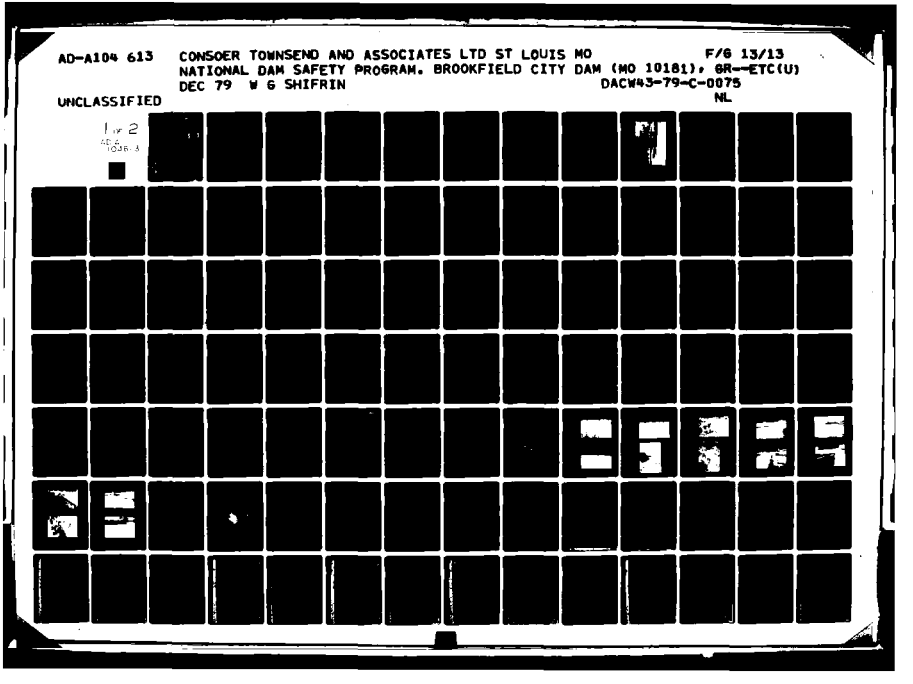

LEVEL II

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GRAND-CHARITON RIVER BASIN

AD A104613

BROOKFIELD CITY DAM
LINN COUNTY, MISSOURI
MO. 10181

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
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St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

DECEMBER 1979

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Brookfield City Dam (Mo. 10181) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Brookfield City Dam (Mo. 10181).

It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED 1 MAR 1980
Chief, Engineering Division — Date: 31 MAR 1980

APPROVED BY: SIGNED
Colonel, CE, District Engineer — Date: 31 MAR [illegible]

BROOKFIELD CITY DAM
LINN COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10181

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
CONSOER, TOWNSEND AND ASSOCIATES, LTD.
ST. LOUIS, MISSOURI
AND
ENGINEERING CONSULTANTS, INC.
ENGLEWOOD, COLORADO
A JOINT VENTURE

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

DECEMBER 1979

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Brookfield City Dam, Missouri Inv. No. 10181
State Located:	Missouri
County Located:	Linn
Stream:	An unnamed tributary of the West Yellow Creek
Date of Inspection:	August 22, 1979

Assessment of General Condition

Brookfield City Dam was inspected by the engineering firms of Consoer, Townsend and Associates, Ltd., and Engineering Consultants, Inc. (A Joint Venture) of St. Louis, Missouri according to the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of Federal and State agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. Within the estimated damage zone of two miles downstream of the dam are five dwellings, the Brookfield Country Club Lake and Dam, State Highway 11 and a railroad bridge which may be subjected to flooding, with possible damage and/or destruction,

and possible loss of life. Brookfield City Dam is in the intermediate size classification since it is more than 40 feet high and impounds more than 1,000 acre-feet but less than 50,000 acre-feet of water.

Our inspection and evaluation indicates that the spillway of Brookfield City Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Brookfield City Dam, being an intermediate size dam with a high hazard potential, is required by the guidelines to pass the Probable Maximum Flood without overtopping. It was determined that the reservoir/spillway system can accommodate 89 percent of the Probable Maximum Flood without overtopping the dam. Our evaluation indicates that the reservoir/spillway system will accommodate the 100-year flood without overtopping.

The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. The 100-year flood is defined as a flood having a one percent chance of being equalled or exceeded during any given year.

Other deficiencies noted by the inspection team were: the sloughing of the upstream slope from 296 to 500 feet to the left from the left edge of the spillway; minor wave erosion on the upstream slope; the tree stumps on the upstream slope; the seepage observed at the toe of the dam; an unstable right retaining wall of the spillway; the vegetation upstream of the central section of the spillway and in the downstream channel; rodent activity on the embankment; a need for periodic inspection by a qualified engineer and a lack of maintenance schedule. The lack of stability and seepage analyses on record is also a deficiency that should be corrected.

It is recommended that the owner take action to correct or control the deficiencies described above.

Walter G. Shifrin, P.E.

Overview of Brookfield City Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

BROOKFIELD CITY DAM, I.D. No. 10181

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NATIONAL DAM SAFETY PROGRAM

BROOKFIELD CITY DAM, Missouri Inv. No. 10181

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for Brookfield City Dam was carried out under Contract DACW 43-79-C-0075 between the Department of the Army, St. Louis District, Corps of Engineers, and the engineering firms of Consoer, Townsend & Associates, Ltd., and Engineering Consultants, Inc. (A Joint Venture), of St. Louis, Missouri.

b. Purpose of Inspection

The visual inspection of Brookfield City Dam was made on August 22, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an assessment of hydrologic and hydraulic conditions at the site; presents an assessment as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing, and detailed analyses were not within the scope of this study. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that reference in this report to left or right abutments is as viewed looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to the east abutment or side, and right to the west abutment or side.

d. Evaluation Criteria

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in the publication "Recommended Guidelines for Safety Inspection of Dams", Appendix D. These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 Description of the Project

a. Description of Dam and Appurtenances

The following description is based on observations and measurements made during the visual inspection, and available drawings.

The dam is a homogeneous structure between earth abutments. The crest is 18 feet wide and 1350 feet long. The crest elevation is 805 feet above MSL, and the maximum height of the embankment is 44 feet. According to the available drawings, the upstream and downstream slope are 1V to 3H and 1V to 3.5H, respectively. Riprap was provided for slope protection on the upstream slope.

According to the available drawings, a cutoff trench was provided upstream of the centerline of the dam. The trench is 4 feet deep with a bottom width of 12 feet and side slopes of 0.5V to 1H.

The spillway for Brookfield City Dam is located adjacent to the right abutment. The spillway is a rectangular, concrete-lined, uncontrolled open chute channel. The control section has a bottom width of 100 feet with vertical side walls 5.5 feet high. The spillway chute channel is 390 feet in length. According to the plans, the spillway is provided with 5 slab drains, but only 3 are known to exist. Energy dissipators were constructed at the downstream end of the channel.

A regulated outlet works used in the Brookfield domestic water supply system was provided for the dam. The water supply system associated with the dam consists of two centrifugal pumps located in a pumphouse which is located immediately downstream of the dam. The pumphouse is located approximately 450 feet to the right of the left abutment. Each pump is controlled by a 12-inch butterfly valve. The capacity of each pump is 750 to 1000 gpm. The intake of the system consists of two 10-inch steel pipes, 50 feet in length, connected to a manifold which can swivel to allow the ends of the pipes to be lowered and raised. A wood piling tower was provided in the reservoir with a hand operated winch used to raise and lower the intake. A strainer was provided on the end of each pipe. From the manifold, a 14-inch C.I.P. encased in concrete passes under the embankment to the pumphouse where the pipe branches into two 12-inch cast iron pipes. The two pipes pass through the pumping system in the pumphouse and converge into a 12-inch C.I.P. which goes to some storage lagoons. A pump is located at the storage lagoons which can pump water back into the Brookfield City reservoir through the same system. On one of the 12-inch lines into the pumphouse, a 12-inch drain pipe was provided which is controlled by a gate valve.

b. Location

The Brookfield City Dam is located on an unnamed tributary of the West Yellow Creek in Linn County, Missouri. The nearest community is Brookfield, which is about 2 miles to the west of the damsite. The dam and lake are located in Sections 33 and 34, Township 58 North, Range 19 West on the Brookfield Quadrangle Sheet (15 minute series).

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams", by the U.S. Department of the Army, Office of the Chief Engineer, the dam is classified in the dam size category as being "Intermediate" since its storage is greater than 1,000 acre-feet and less than 50,000 acre-feet. The dam is also classified as "Intermediate" in dam size category because its height is less than 100 feet and greater than 40 feet. The overall size classification is, accordingly, "Intermediate" in size.

d. Hazard Classification

The dam has been classified as having "High" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. Our findings concur with the classification. Within the estimated damage zone, which extends approximately 2 miles downstream from the dam, are five dwellings, the Brookfield Country Club Lake and Dam, State Highway 11 and a railroad bridge.

e. Ownership

The Brookfield City Dam is owned by the City of Brookfield. The mailing address is Brookfield City Hall, c/o Ray Epperly, Water Superintendent, Brookfield, Missouri, 64628.

f. Purpose of Dam

The main purpose of the dam is to impound water for domestic water supply and recreational use.

g. Design and Construction History

Brookfield City Dam was designed in 1959 by E. T. Archer Engineering of Kansas City, Missouri. According to the Brookfield Water Superintendent, Mr. Ray Epperly, the dam was constructed by Gibson and Bowles Construction of Lees Summit, Missouri.

h. Normal Operational Procedures

There are no specific operational procedures for the dam or the appurtenant structures. The only facilities at the site which require operation are the two pumps located in the pumphouse at the toe of the dam. The operational procedures of the pumps varies depending upon the demand for water. The pumps are used mostly during the winter months. The reservoir is allowed to remain as full as possible with the water level being controlled by rainfall, runoff, evaporation, the elevation of the spillway crest and the demand for water.

According to Tom Sturguess of the Brookfield Water Department, the pumping system associated with water supply lines allow them to pump water either to or from the city holding ponds located about a mile southwest from the reservoir. Mr. Sturguess also noted that it is possible to pump water from Yellow Creek into the reservoir to increase the quantity in storage.

1.3 Pertinent Data

a. Drainage Area (square miles): 1.1

b. Discharge at Damsite

Estimated experienced maximum flood (cfs):	NA
Estimated ungated spillway capacity with reservoir at top of dam elevation (cfs):	3446

c. Elevation (Feet above MSL)

Top of dam:	805.0
Spillway crest:	800.0 (assumed)
Normal Pool:	800.0
Maximum Pool (PMF):	805.30

d. Reservoir

Length of pool with water surface at top of dam elevation (feet):	5200

e. Storage (Acre-Feet)

Top of dam:	2539
Spillway crest:	1892
Normal Pool:	1892
Maximum Pool (PMF):	2591

f. Reservoir Surface (Acres)

Top of dam:	141
Spillway crest:	118
Normal Pool:	118
Maximum Pool (PMF):	143

g. Dam

Type:	Earthfill
Length:	1350 feet
Structural Height:	44 feet

Hydraulic Height:	44 feet
Top width:	18 feet
Side slopes:	
Downstream	1V to 3.5H
Upstream	1V to 3H
Zoning:	Homogeneous
Impervious core:	NA
Cutoff:	Cutoff trench, 12 foot wide, 4 foot deep with side slopes of 0.5V to 1H.
Grout curtain:	Unknown

h. Diversion and Regulating Tunnel None

i. Spillway

Type:	Rectangular open chute channel, uncontrolled
Length of crest:	100 feet
Crest Elevation (feet above MSL):	800 (assumed)

j. Regulating Outlets

Type:	14-inch steel water supply pipe
Length:	430 feet (According to plans)
Closure:	Two 12-inch butterfly valves
Maximum Capacity:	1500 to 2000 gpm

SECTION 2 : ENGINEERING DATA

2.1 Design

A full set of original design drawings are available from the Department of Natural Resources, Macon, Missouri. A partial set of the drawings are included as part of this report. The design engineering firm of E.T. Archer of Kansas City, Missouri was unable to provide any design calculations or specifications. The dam and appurtenant structures were part of the Sections III and IV Waterworks Improvements for Brookfield, Missouri project.

2.2 Construction

No construction records or as-built drawings were available for the Brookfield City Dam. The dam was constructed by Gibson and Bowles Construction Company of Lees Summit, Missouri.

2.3 Operation

No operation records are available for the Brookfield City Dam.

2.4 Evaluation

a. Availability

The availability of engineering data is poor and consists only of the design drawings mentioned in Section 2.1, State Geological Maps and U.S.G.S. Quadrangle Sheets. Information on subsurface soils underneath the dam is available

(see Plate 5). The subsurface soils consist of clayey soils, shale and sand and clay drift. No information on design hydrology, or hydraulic design was available, nor were seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams", which is considered a deficiency.

b. Adequacy

The conclusions presented in this report are based on field measurements, the available engineering data, past performance and present condition of the dam. The data available is inadequate to evaluate the hydraulic and hydrologic capabilities of the dam.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection for Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity

Only a set of design drawings was available for review. From field measurements, the dam appears to have been constructed according to the available drawings, except for the discrepancies described in Section 1.2a.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Brookfield City Dam was made on August 22, 1979. The following persons were present during the inspection:

Name	Affiliation	Disciplines
Dr. M.A. Samad	Engineering Consultants, Inc.	Project Engineer, Hydraulics and Hydrology
Mark R. Haynes	Engineering Consultants, Inc.	Civil, Structural and Mechanical
Dawn L. Jacoby	Engineering Consultants, Inc.	Soils
Peter L. Strauss	Engineering Consultants, Inc.	Geology
Kevin Blume	Consoer, Townsend & Assoc., Ltd.	Civil and Structural
Nancy Olinger	City of Brookfield	City Manager
Lavon Burris	City of Brookfield	Mayor

Tom Sturguess	City of Brookfield	Water Department
Norman Wood	Rhodes-Sayre & Associates, Consulting Engineers for the City of Brookfield	Professional Engineer

Specific observations are discussed below.

b. Dam

The dam is generally in good condition. The dam crest is protected from surface erosion by a well maintained cover of grass. No significant deviatons in horizontal or vertical alignment were apparent. No bulges or depressions were observed. Non-continuous cracks measuring approximately 1-inch wide were observed on the crest, downstream slope, and the contact with the left abutment. The nature and cause of these cracks were not readily apparent, however; they do not appear to be related to slope movement. Tension cracks along the upstream side were observed in an area located 296 feet to 500 feet from the spillway. The crest was wider in this area. According to Mr. Tom Sturguess the dam has never been overtopped and there was no evidence indicating the contrary.

The upstream slope is generally protected from wave action by an adequate cover of sandstone riprap. Some minor erosion has occurred above the riprap due to wave action. The upper section of the slope is protected by a grass cover. Several bushes and large tree stumps were observed on the slope. The section of the embankment located from 296 feet to 500 feet to the left of the spillway has been badly undercut. The sandstone riprap has been replaced with concrete rubble.

The slope is sloughing as indicated by the tension cracks on the crest in this section.

The downstream slope is protected by a well maintained grass cover. No bulges or depressions were observed. There was some evidence of rodent activity on the slope. The embankment slope, from 206 feet to 318 feet, from the east edge of the spillway exhibited signs of seepage. Standing water was observed in the cattails located on the slope immediately above the toe. No signs of instability were observed.

The abutments were at approximately the same elevation as the crest of the dam. No instability of the abutment was observed. No seepage along the abutment and embankment contact was observed. Both abutments were protected from surface runoff by an adequate grass cover. The right abutment supports a gravel road.

c. Project Soils and Geology

According to the "Missouri General Soil Map and Soil Association Description" published by the Soil Conservation Service, the materials in the general area of the dam belong to the soil series of Pershing-Armstrong-Gara in the Deep Loess and Drift forest. The soils are basically formed from loess and glacial till. The permeability of these soils range from slow to moderately slow. The subsurface soils underneath the dam consist of clayey soils, shale and sand and clay drift (see Plate 5).

The damsite is physiographically located in the Dissected Till Plains Section of the Central Lowlands Physiographic Province, according to Nevin Fenneman's "Physiography of the Eastern United States." This section is distinguished from the Young Drift section on the north and from the Till Plains on the east by the stage it has reached in the post-glacial erosion cycle. Broadly generalized, this section is a nearly flat till plain submature to mature in its erosion cycle.

No faults have been identified in the vicinity of the dam.

Some minor folding has been identified in Linn County. The closest trace of any fold to the dam would be the northwest end of the College Mound-Bucklin anticline, 12 miles to the east, which had its last movement in late or post-Pennsylvanian. This minor structure has no effect on the dam.

The site bedrock geology, beneath the drift, as shown on the Geologic Map of Missouri, (1979), is interbedded Pennsylvanian age shales, limestones, sandstones. These strata generally strike north-south and dip gently to the west.

No bedrock was seen at or in the vicinity of the damsite. The entire area is mantled by glacial drift.

d. Appurtenant Structures

(1) Spillway

The overall condition of the spillway channel appeared to be good. Minor temperature cracks in the concrete were observed in the slab and left retaining wall of the spillway channel. No spalling of the concrete was observed. The entire right retaining wall of the channel, however, appeared to be unstable. In several locations along the wall, displacements from 1 to 3 inches were observed along the top at contraction and construction joints and portions of the wall appeared to be leaning forward. The last 130 feet of the wall was tilted forward approximately 20 degrees. The top of the wall was displaced 16 inches. The separation appears to have occurred at a construction joint. No reinforcement was exposed. No other instability was observed. The retaining walls were provided with weep holes at 20 foot centers and placed 6 inches above the spillway slab. A 2-foot high chain link trashrack was provided for the spillway. Some tall vegetation was growing upstream of the trashrack, however, the trashrack was unobstructed. The energy dissipators show no signs of deterioration.

(2) Outlet Works

According to Mr. Tom Sturguess of the Water Department of the City of Brookfield, the water supply system is operable. All valves are operable and the pumps are used regularly. The intake was inaccessible. The tower, which regulates the elevation of the intake, collapsed in 1976, therefore, the intake is lying at the bottom of the reservoir. Plans are being made to raise the structure.

e. Reservoir Area

The water surface elevation was at 798.7 feet above MSL on the day of the inspection.

The slopes along the reservoir rim are gently sloped with a good grass cover. In the past, the reservoir rim has experienced erosion which has been corrected by regrading and reseeding the slopes. No evidence of instability or erosion of the slopes was observed.

f. Downstream Channel

The downstream channel is obstructed by a heavy growth of vegetation and trees. The channel is about 15 feet wide and 5 feet deep. The channel meanders from the downstream end of the spillway channel to a culvert, 7 feet high by 14 feet wide, which passes under State Highway 11. Beyond the highway box culvert, the channel flows into the Brookfield Country Club Lake.

3.2 Evaluation

The visual inspection did not reveal any items which are sufficiently significant to indicate a need for immediate remedial action, however, the remedial measures in Section 7.2 should be undertaken within a reasonable period of time.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Brookfield City Dam was built for domestic water supply for the City of Brookfield and the surrounding community. It is also used for recreational purposes.

No formal operational procedures are in effect for this dam. The pumps of the water supply system are operated depending upon the demand for water.

4.2 Maintenance of Dam

The dam is maintained by the City of Brookfield under the direction of Mr. Ray Epperly, the city Water Superintendent. The dam itself appears to be well maintained. The slopes and crest are mowed periodically and no trees have been allowed to grow on the embankment. Nevertheless, several items as mentioned in Section 7.2 should be attended to within a reasonable period of time.

4.3 Maintenance of Operating Facilities

The pumps are kept in operable condition. On the day of the inspection, the pumps were not operating.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any warning system in effect for this dam.

4.5 Evaluation

The operation and maintenance for Brookfield City Dam seems to be adequate. Nevertheless, the remedial measures as described in Section 7 should be undertaken as recommended.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The watershed area of the Brookfield City Dam upstream from the dam axis consists of approximately 702 acres. The watershed area is mostly pasture and range land. Land gradients in the higher regions of the watershed average roughly 4 percent, and in the lower areas surrounding the reservoir average about 8 percent. The Brookfield City Dam Reservoir is located on an unnamed tributary of the West Yellow Creek. The reservoir is about 1.6 miles upstream from the confluence of the unnamed tributary and West Yellow Creek. At its longest arm the watershed is approximately 1/2 mile long. A drainage map showing the watershed is presented as Plate 1 in Appendix B.

Evaluation of the hydraulic and hydrologic features of Brookfield City Dam was based on criteria set forth in the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams", and additional guidance provided by the St. Louis District of the Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation (PMP) using the methods outlined in the U.S. Weather Bureau Publication, Hydrometeorological Report No. 33. The probable maximum storm duration was set at 24 hours, and storm rainfall distribution was based on criteria given in the Corps of Engineers' EM 1110-2-1411 (Standard Project Storm). The Soil Conservation Service (SCS) method was used for

deriving the unit hydrograph, utilizing the Corps of Engineers' computer program HEC-1 (Dam Safety Version). The unit hydrograph parameters are presented in Appendix B. The SCS method was also used for determining the loss rate. The hydrologic soil group of the watershed was determined by use of published soil maps. The hydrologic soil group of the watershed and the SCS curve number are presented in Appendix B. The curve number, the unit hydrograph parameters, the PMP index rainfall and the percentages for various durations were directly input to the HEC-1 (Dam Safety Version) computer program to obtain the PMF hydrograph. The computed peak discharges of the PMF and one-half of the PMF are 13,909 cfs and 6,954 cfs, respectively.

Both the PMF and one-half of the PMF inflow hydrographs were routed through the reservoir by the Modified Puls Method also utilizing the HEC-1 (Dam Safety Version) computer program. The reservoir was assumed at the spillway crest level at the start of the routing computation. The peak outflow discharges for the PMF and one-half of the PMF are 4,548 and 1,723 cfs, respectively. Only the PMF when routed through the reservoir resulted in overtopping of the dam.

The size of physical features utilized to develop the stage-outflow relation for the spillway and overtopping of the dam were determined from field notes and sketches, prepared during the field inspection. The reservoir stage-capacity data were based on the U.S.G.S. Brookfield, Missouri Quadrangle topographic map (7.5 minute series). The spillway and dam overtop rating curve and the reservoir capacity curve are presented in Plates 2 & 3 respectively in Appendix B.

From the standpoint of dam safety, the hydrologic design of a dam must aim at avoiding overtopping. Overtopping is especially dangerous for an earth dam because of its erosive characteristics. The safe hydrologic design of an embankment dam requires a spillway discharge capability, in combination with an embankment crest height that can handle a very large and exceedingly rare flood without dam overtopping.

The Corps of Engineers design dams to safely pass the Probable Maximum Flood that is estimated could be generated from the dam's watershed. This is the generally accepted criterion for major dams throughout the world, and is the standard for dam safety where overtopping would pose any threat to human life. Accordingly, the hydrologic requirement for safety for this dam is the capability to pass the Probable Maximum Flood without overtopping.

b. Experience Data

It is believed that records of reservoir stage or spillway discharge are not maintained for this site.

c. Visual Observations

Observations made of the spillway during the visual inspection are discussed in Section 3.1.c(1) and evaluated in Section 3.2.

d. Overtopping Potential

As indicated in Section 5.1.a, only the Probable Maximum Flood when routed through the reservoir, resulted in overtopping of the dam. The peak outflow discharges for the PMF and one-half of the PMF are 4,548 and 1,723 cfs, respec-

tively. The maximum capacity of the spillway just before overtopping the dam is 3446 cfs. The PMF overtopped the dam crest by 0.30 feet. The total duration of embankment overflow is 0.75 hour. The spillway/reservoir system of Brookfield City Dam is capable of accommodating a flood equal to approximately 89 percent of the PMF before overtopping the dam. The spillway/reservoir system of Brookfield City Dam will accommodate the 100-year flood without overtopping.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. The estimated damage zone extends approximately two miles downstream of the dam. Within the damage zone are five dwellings, the Brookfield Country Club Lake and Dam, State Highway 11 and a railroad bridge.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The upstream slope is protected by riprap and vegetation. The dam crest and the downstream slope are protected by vegetation. The dam shows no signs of instability except for the area on the upstream slope to the left of the spillway which was repaired. The area that was severely undercut and is now sloughing should be monitored and repairs made as required to ensure the safety of the dam. The seepage observed at the toe does not appear to affect the structural stability of the dam in its present condition. No flowing seeps were observed. Nevertheless, the seepage area should be monitored and any changes in quantity, or color should be investigated. In the absence of seepage and stability analyses, no quantative evaluation of the structural stability can be made.

The structural stability of the right retaining wall of the spillway channel appears to be in jeopardy. This condition, however, does not affect the structural integrity of the dam. If the wall was to collapse, the hydraulic capacity of the spillway would not be affected. No other instabilities were observed in the spillway or outlet works.

b. Design and Construction Data

No design computations were uncovered during the report preparation phase. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of embankment compaction are available for use in a stability analysis.

c. Operating Records

No operating records are available relating to the stability of the dam or appurtenant structures. The water level on the day of the inspection was 1 foot 4 inches below the crest of the spillway, and it is assumed that the reservoir remains close to full at all times. The operation of the pumps depends on the demand for water.

d. Post Construction Changes

Stated in a letter addressed to the Director of Public Works of Brookfield, from Rhodes-Sayre & Associates, the consulting engineers for the city of Brookfield, a large slide occurred on the upstream slope several years prior to 1978. The slide was repaired by dumping concrete rubble on the area of the slide and then covering the area with soil. Consequently, the crest of the dam was widened. The upstream slope is steep in this area. This area appears to be the same area mentioned in Section 3.1b.

e. Seismic Stability

The dam is located in Seismic Zone 1, as defined in "Recommended Guidelines For Safety Inspection of Dams" as prepared by the Corps of Engineers. An earthquake of the magnitude expected in Seismic Zone 1 should not cause significant distress to a well designed and constructed earth dam.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation, however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is also important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be assurance that an unsafe condition could be detected.

a. Safety

The spillway capacity of Brookfield City Dam was found to be "Inadequate". The spillway/reservoir system will accommodate 89 percent of the PMF without overtopping the dam. The surface soils on the dam are quite silty. The dam is overtopped by about 4 inches during the PMF and the duration of embankment overflow is about one hour. If the material in the dam is silty soil, the dam would be susceptible to erosion and failure during overtopping.

No quantitative evaluation of the safety of the embankment can be made in view of the absence of seepage and stability analyses. The present embankment and appurtenant structures, however, appeared to have performed adequately since its construction without failure. The dam reportedly has never been overtopped and no evidence was uncovered indicating the contrary.

The erosion due to wave action, the unstable area to the left of the spillway on the upstream slope and the seepage observed on the toe do not affect the safety of the dam in their present conditions. Nevertheless, the conditions should be monitored and repairs made as required.

The vegetative growth upstream of the control section of the spillway and in the downstream channel does not pose a danger to the safety of the dam. These obstructions should, however, be removed in order to maintain the hydraulic efficiency of the spillway and the downstream channel.

The activity of burrowing animals observed on the embankment could jeopardize the safety of the dam. The holes created by the animals make avenues for possible piping. The extent of damage to the embankment done by the burrowing animals should be determined and corrective measures undertaken as required.

The tree stumps observed on the upstream slope pose a potential danger to the safety of the dam. Depending upon the extent of the existing root system, the roots as they rot present possible paths for piping through the embankment. Therefore, the stumps and their root systems should be removed from the embankment under the guidance of an engineer experienced in the design and construction of earthen dams.

b. Adequacy of Information

The conclusions presented in this report are based on field measurement, past performance and present condition of the dam. Information on the design hydrology, hydraulic design, and the operation and maintenance of the dam were not available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelies for Safety Inspection of Dams" were also not available, which is considered a deficiency.

c. Urgency

The remedial measures recommended in Paragraph 7.2 should be accomplished within a reasonable period of time.

d. Necessity for Phase II Inspection

Based on results of the Phase I inspection, and if the remedial measures recommended in Paragraph 7.2 are undertaken, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

a. Alternatives

Spillway capacity and/or height of dam should be increased to accommodate the PMF without overtopping the dam.

b. O & M Procedures

1. Repair the unstable right retaining wall in the spillway channel.

2. Remove the tree stumps and their root systems observed on the upstream slope. Removal of the stumps and their root systems should be under the guidance of an engineer experienced in the design and construction of earthen dams.

3. Remove the vegetation from upstream of the control section of the spillway and in the downstream channel.

4. Determine the extent of damage done to the embankment by burrowing animals, if any, and make corrective repairs as required.

5. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of earth dams.

6. Monitor the sloughing occurring on the upstream slope to the left of the spillway and the minor erosion due to wave action and make repairs as necessary.

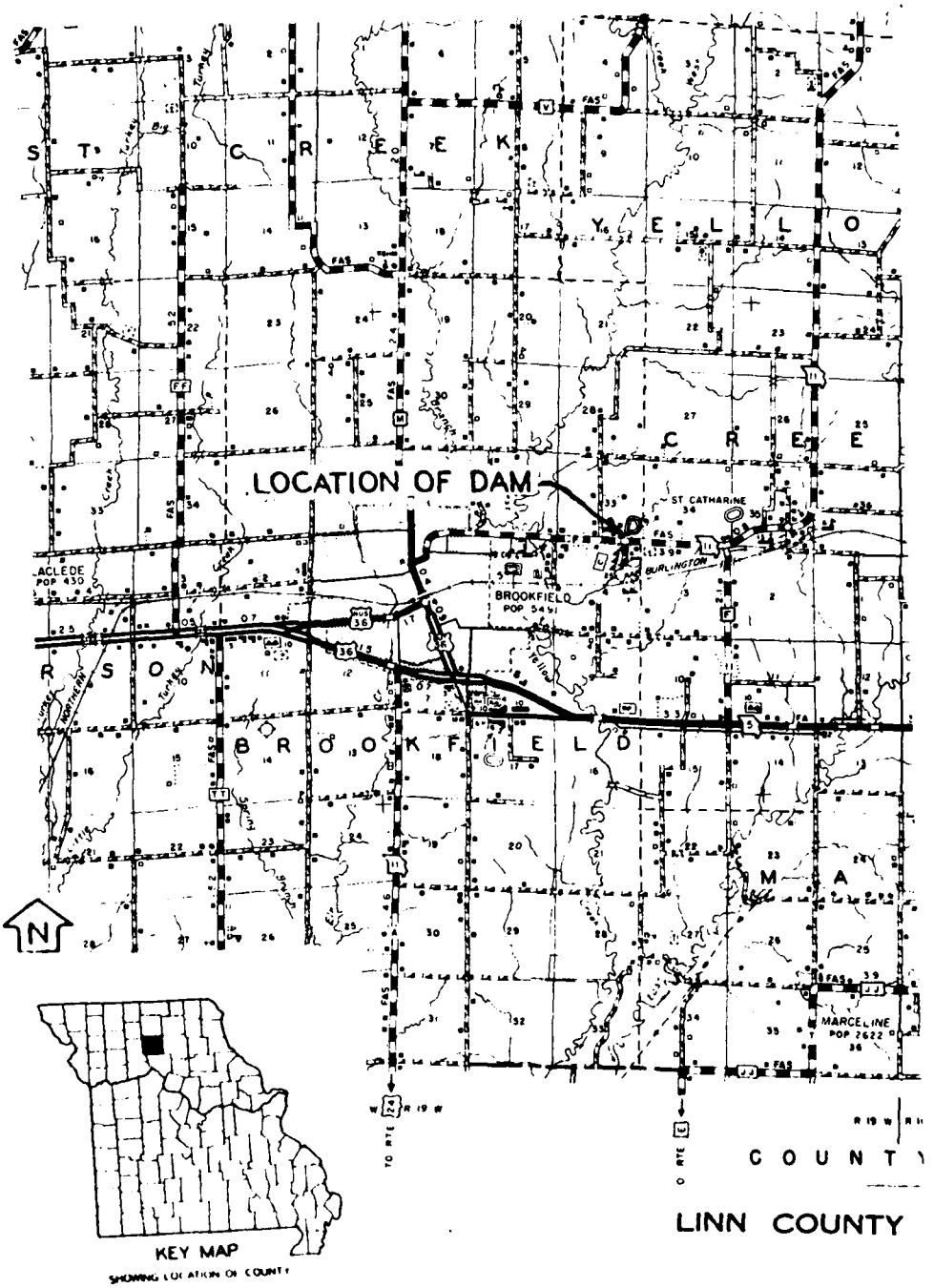
7. Monitor the seepage observed on the downstream slope and any changes in quantity or color should be investigated.

8. The owner should initiate the following programs:

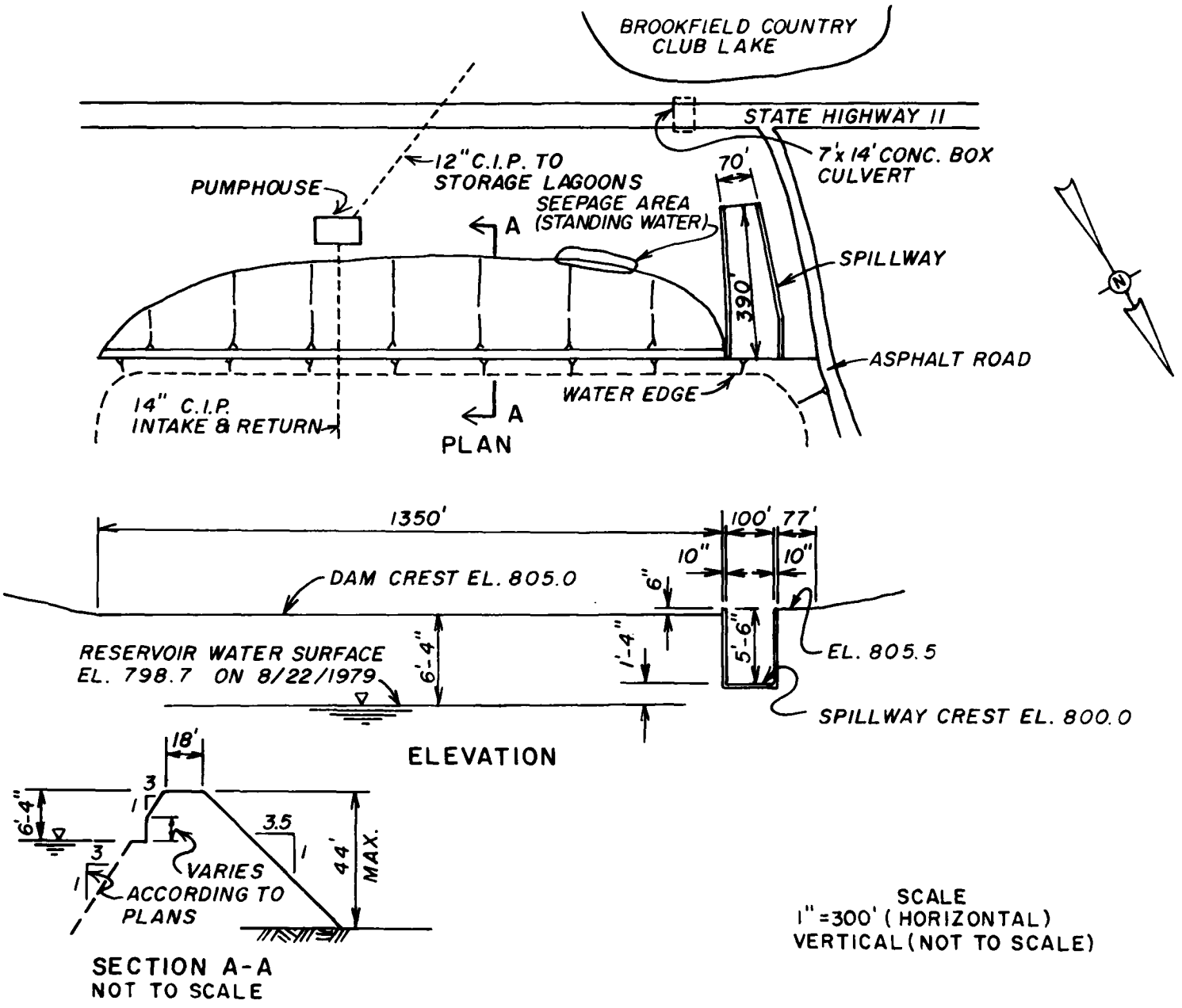
   (a) Periodic inspection of the dam by a professional engineer experienced in the design and construction of earthen dams.

   (b) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

PLATES



LOCATION MAP – BROOKFIELD CITY DAM



BROOKFIELD CITY DAM (MO. 10181)
PLAN, ELEVATION & SECTION

PLATE 2

SECTIONS

WATERWORKS IMP

FOR

BROOKFIE

E.T.ARCHER & CO
CONSULTING ENGI
KANSAS CITY,

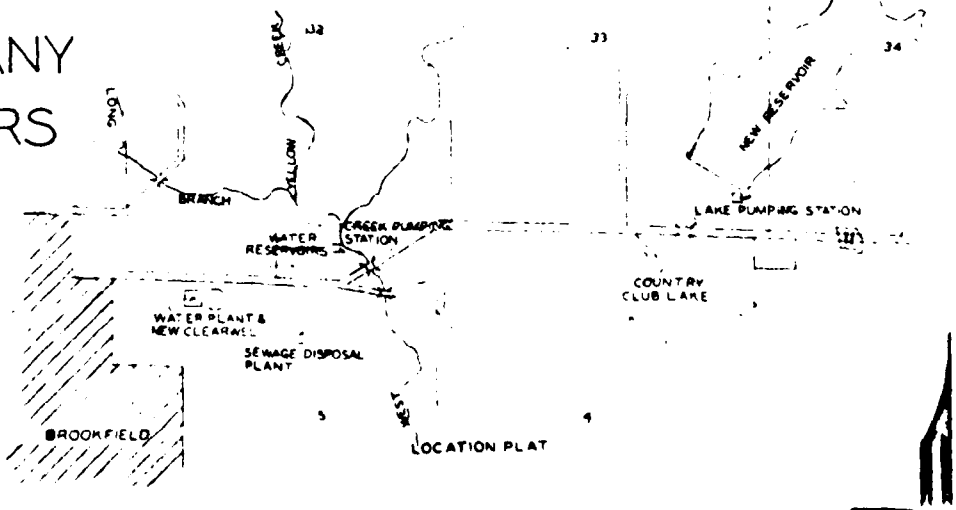
PLATE 3

TIONS III & IV
KS IMPROVEMENTS

FOR

KFIELD, MO.

ARCHER & COMPANY
ONSULTING ENGINEERS
KANSAS CITY, MO.



7-5-16

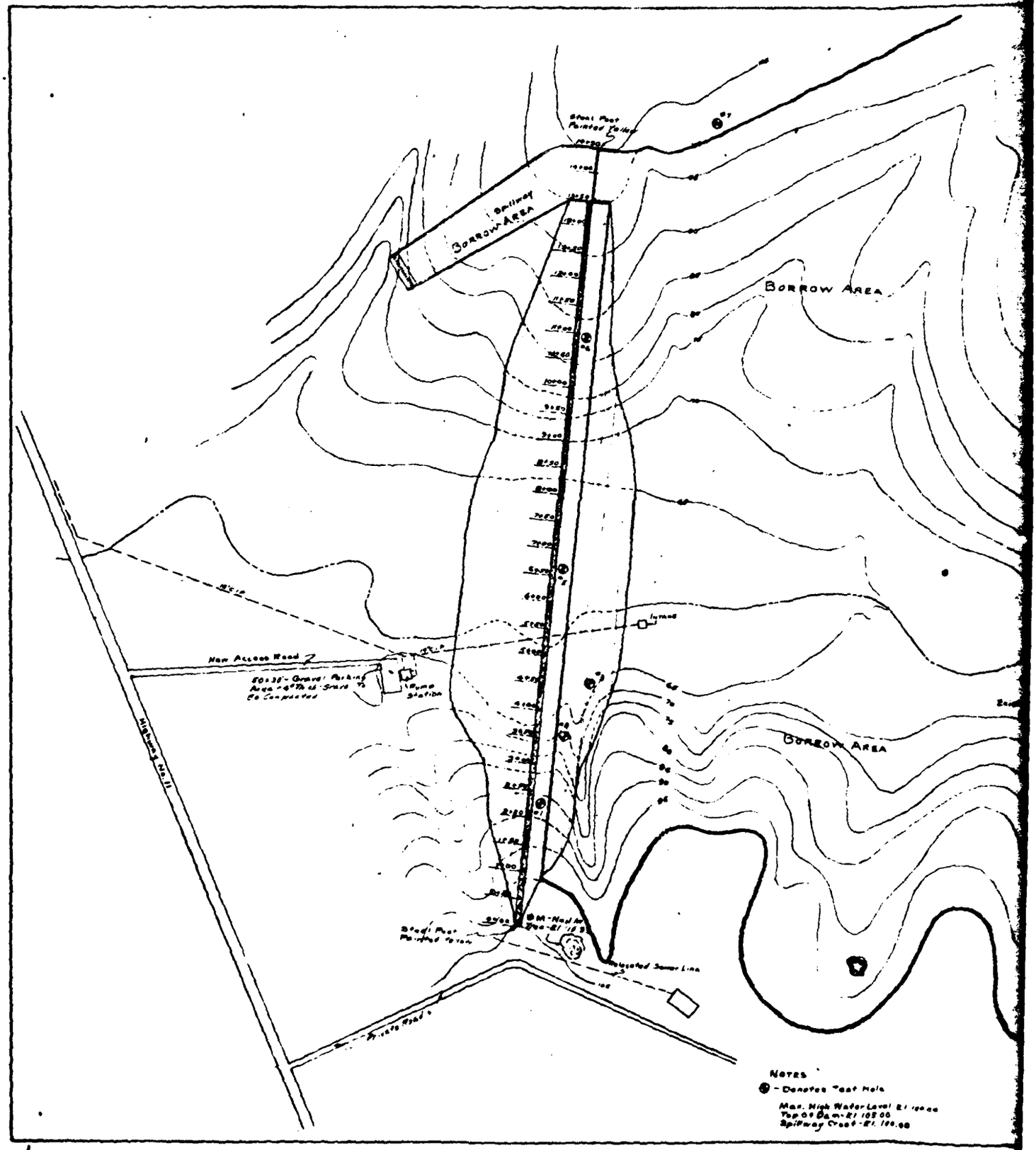
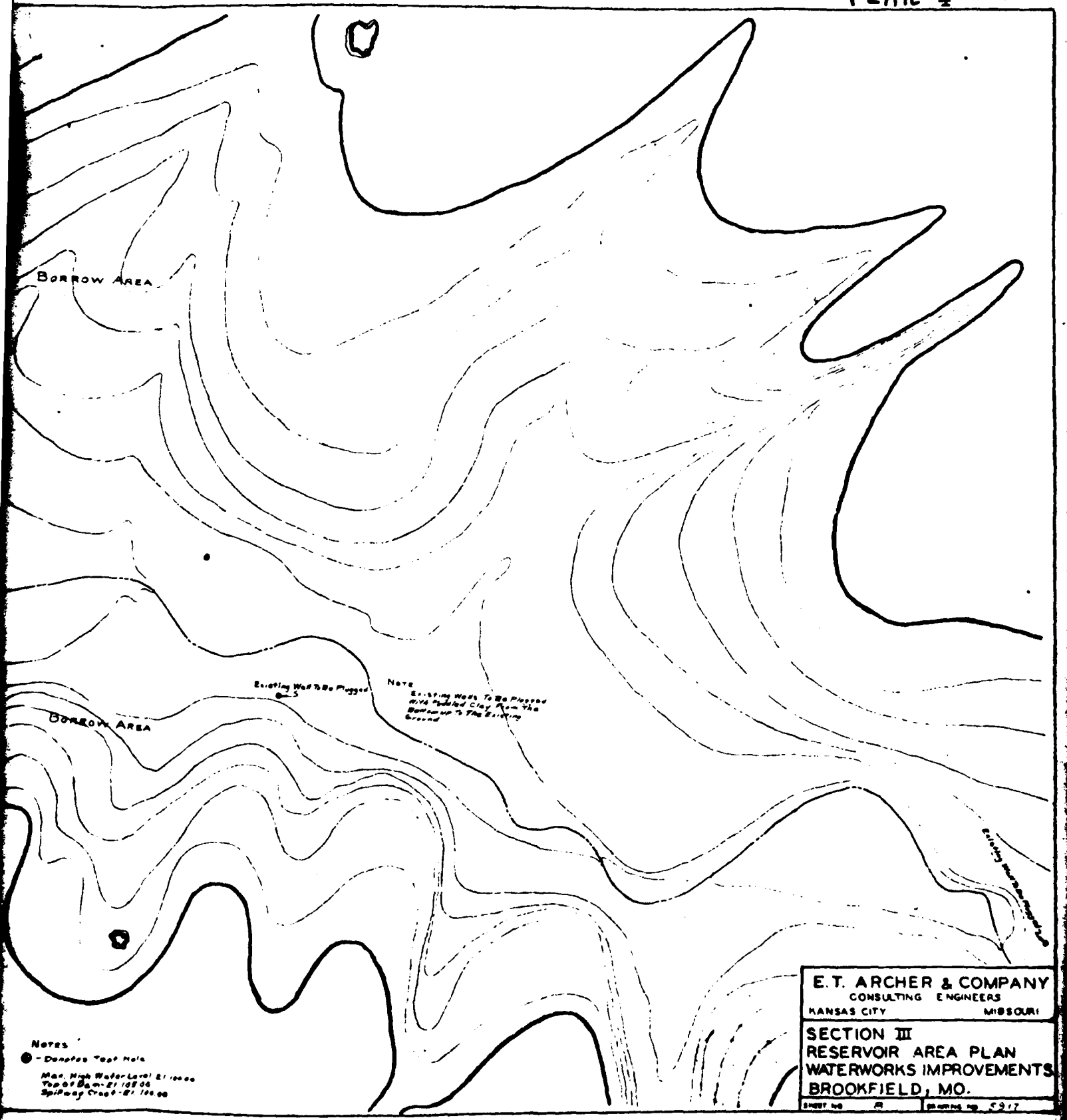

Spillway
Borrow Area
Borrow Area
Borrow Area
New Access Road
Highway No. 11
Notes
- Denotes Test Hole

PLATE 4



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CONSULTING ENGINEERS
KANSAS CITY MISSOURI

SECTION III
RESERVOIR AREA PLAN
WATERWORKS IMPROVEMENTS
BROOKFIELD, MO.

SHEET NO. 3A DRAWING NO. C-917

NOTES
● - Denotes Test Hole
Max. High Water Level El. 100.00
Top of Dam - El. 102.00
Spillway Crest - El. 100.00

2

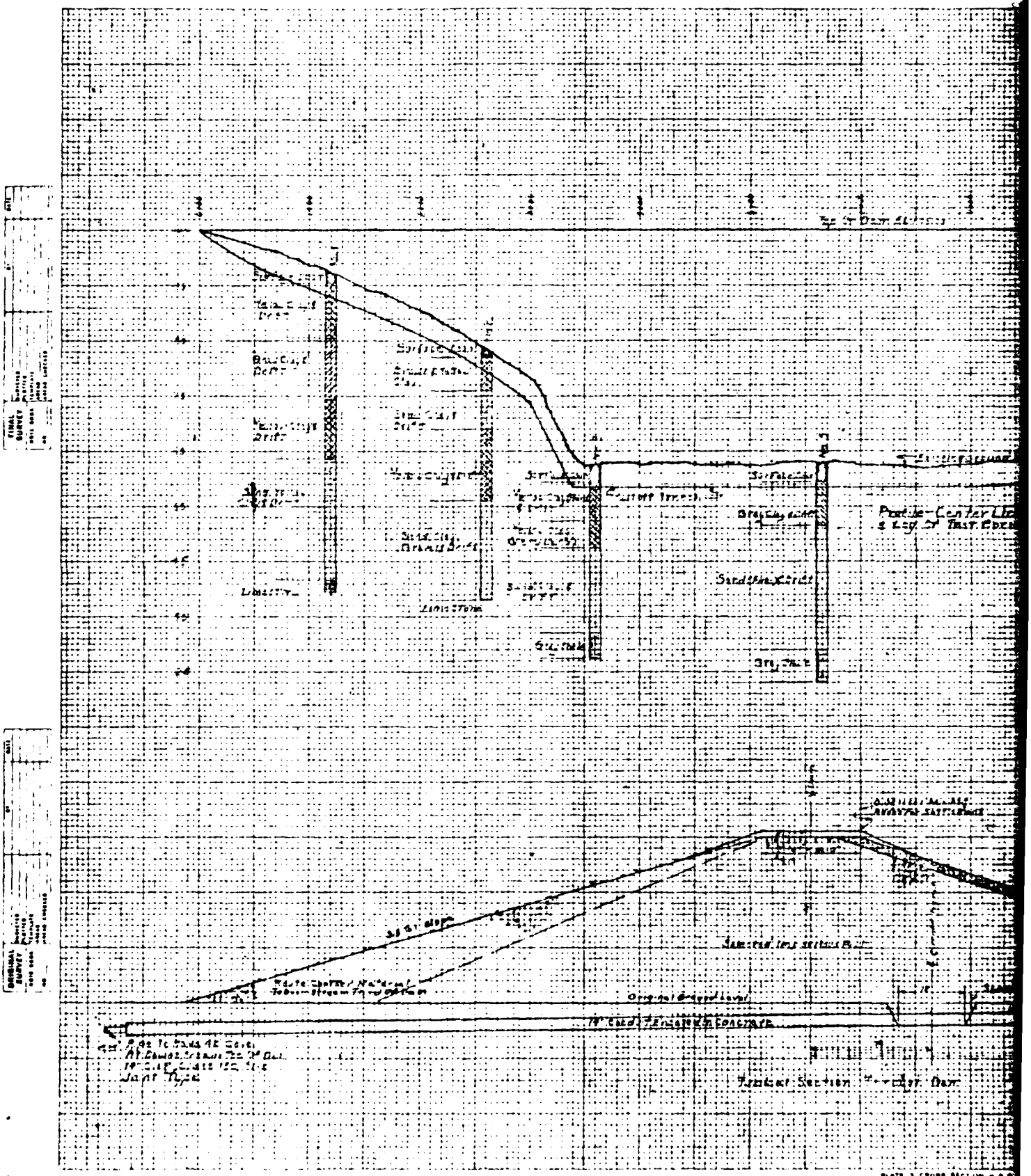
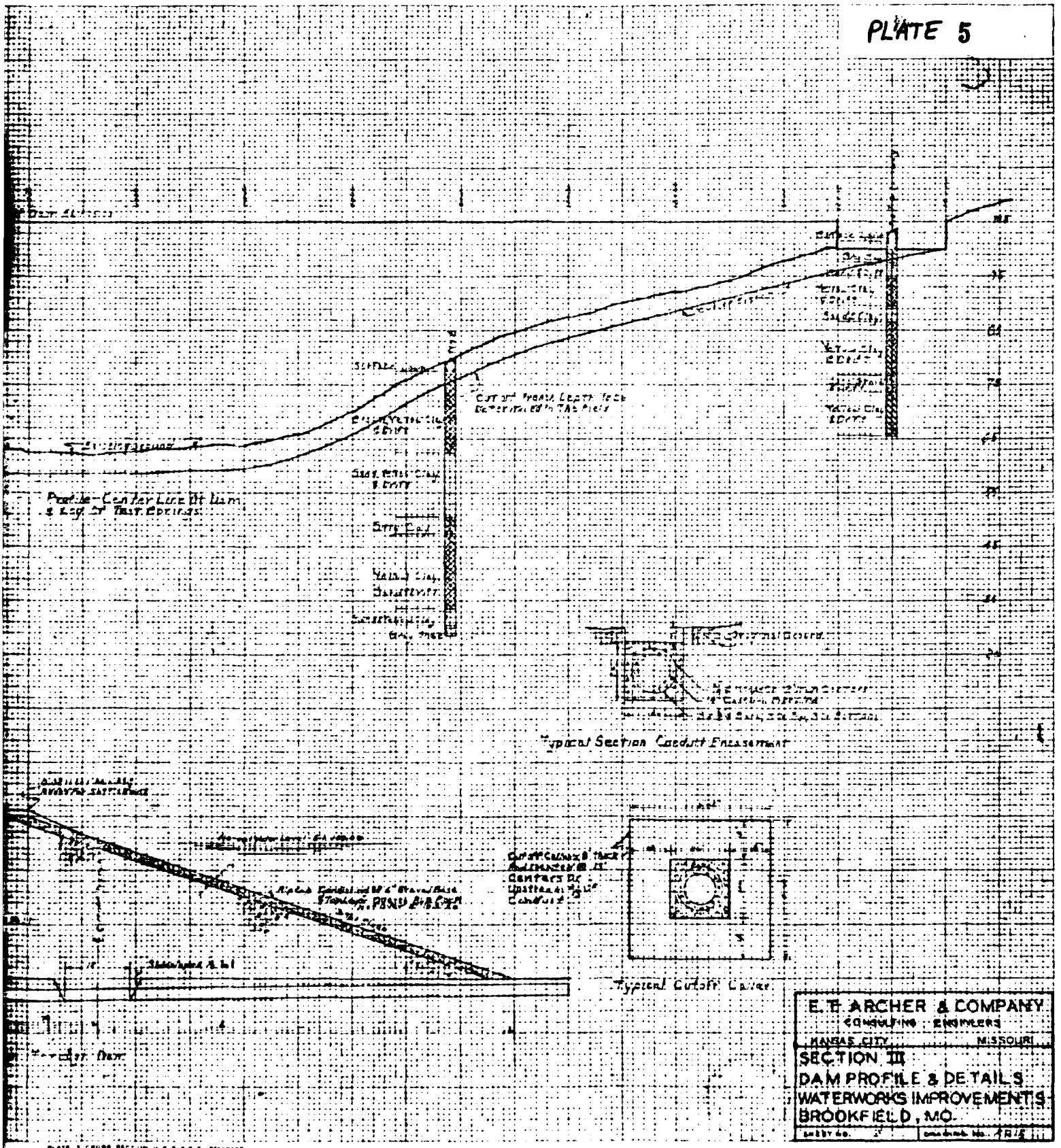


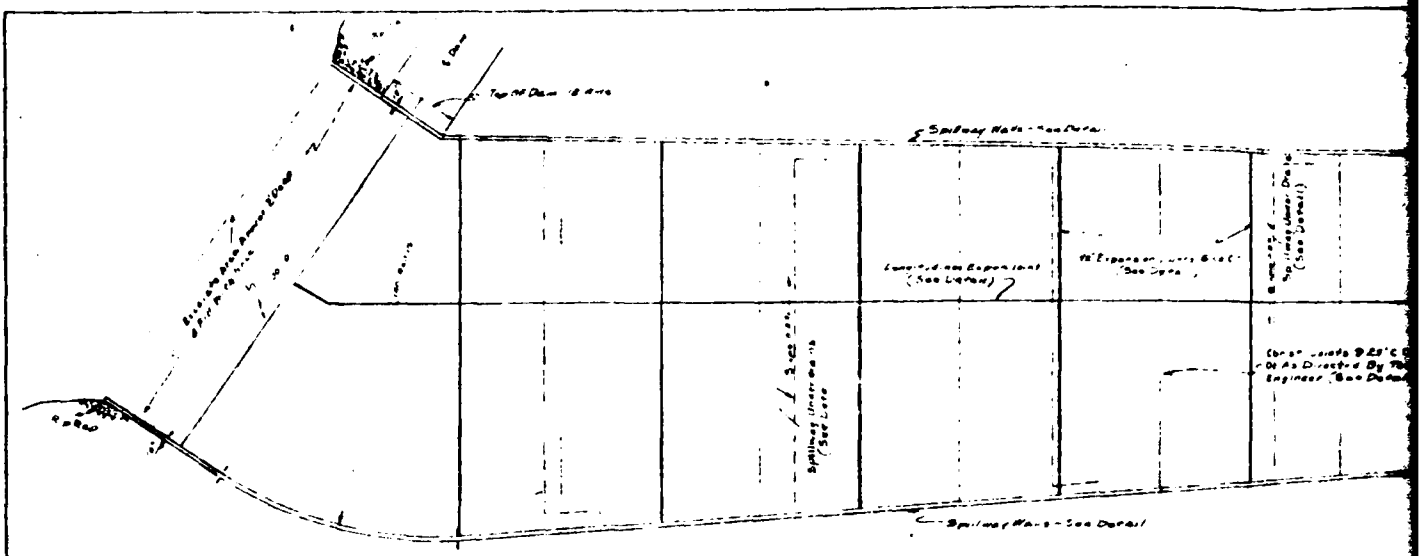
PLATE 5



E. T. ARCHER & COMPANY
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

SECTION III
DAM PROFILE & DETAILS
WATERWORKS IMPROVEMENTS
BROOKFIELD, MO.

2



SPILLWAY PLAN
1"=20'

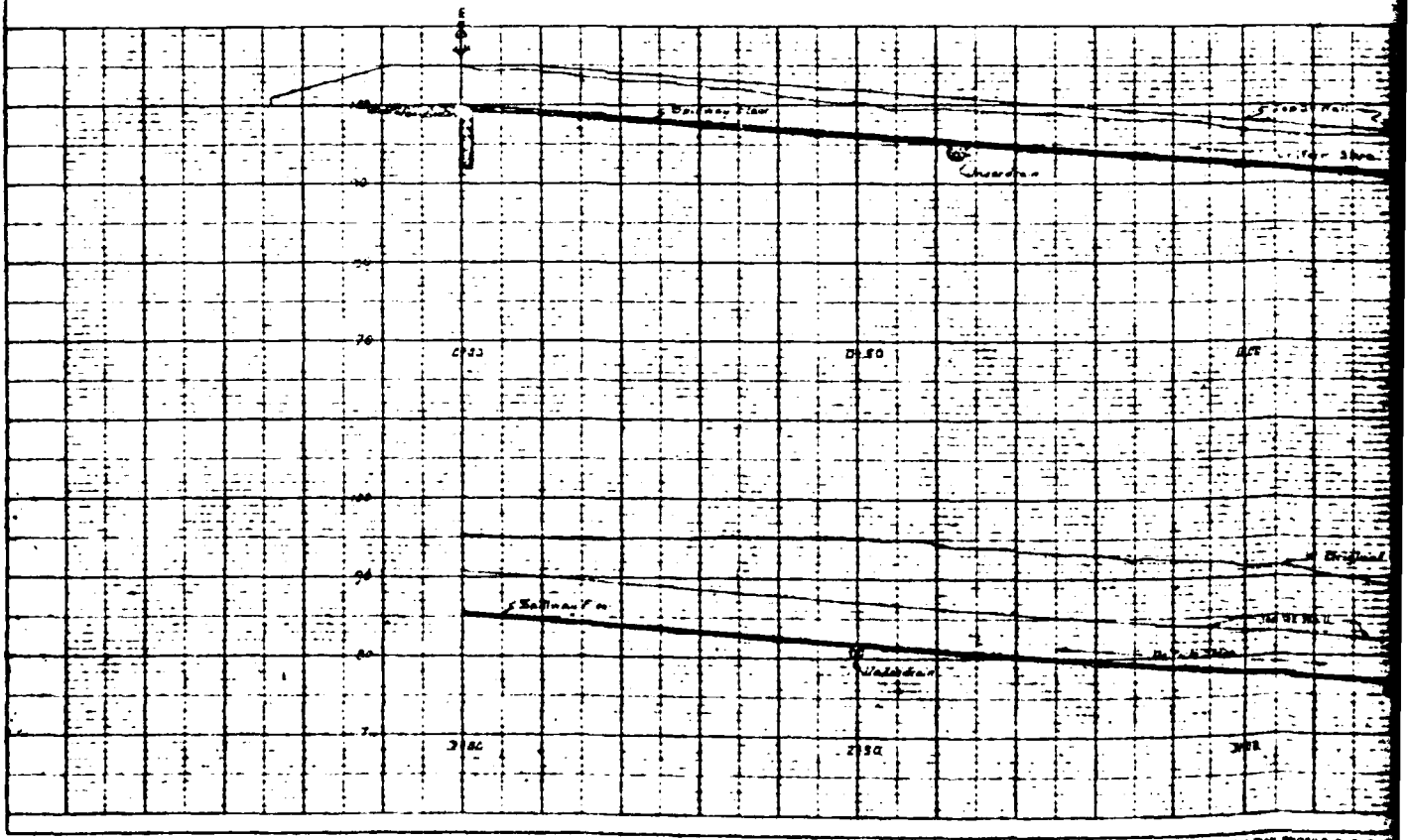
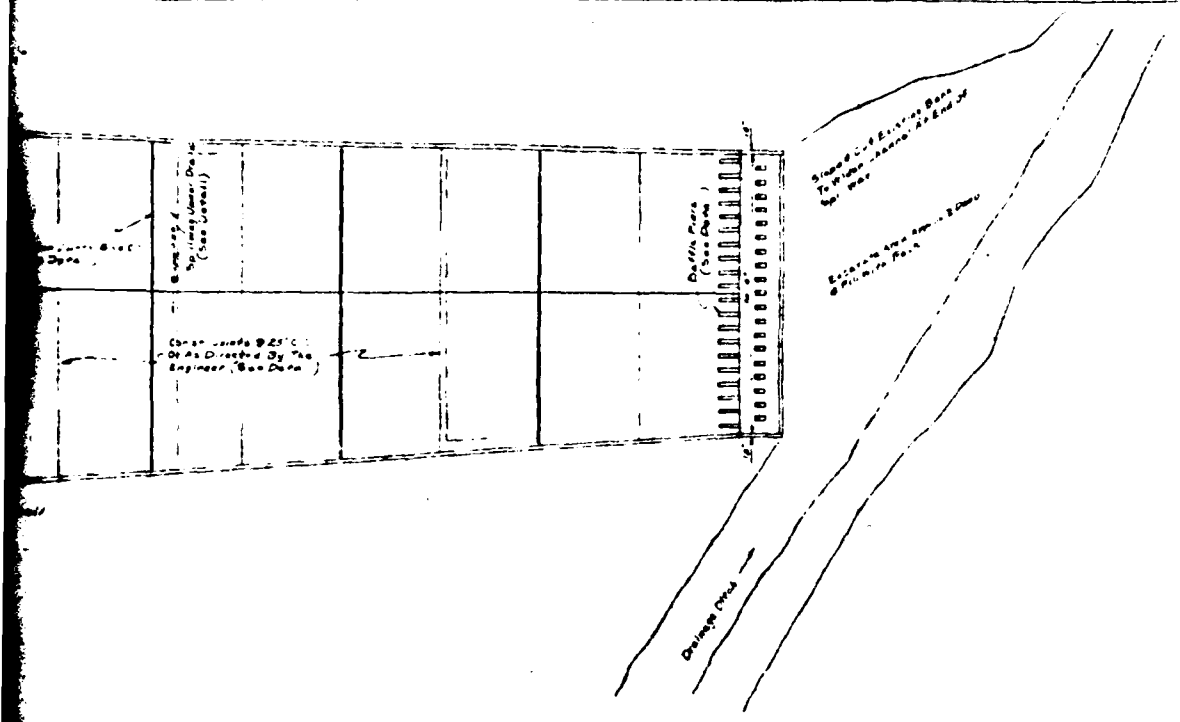
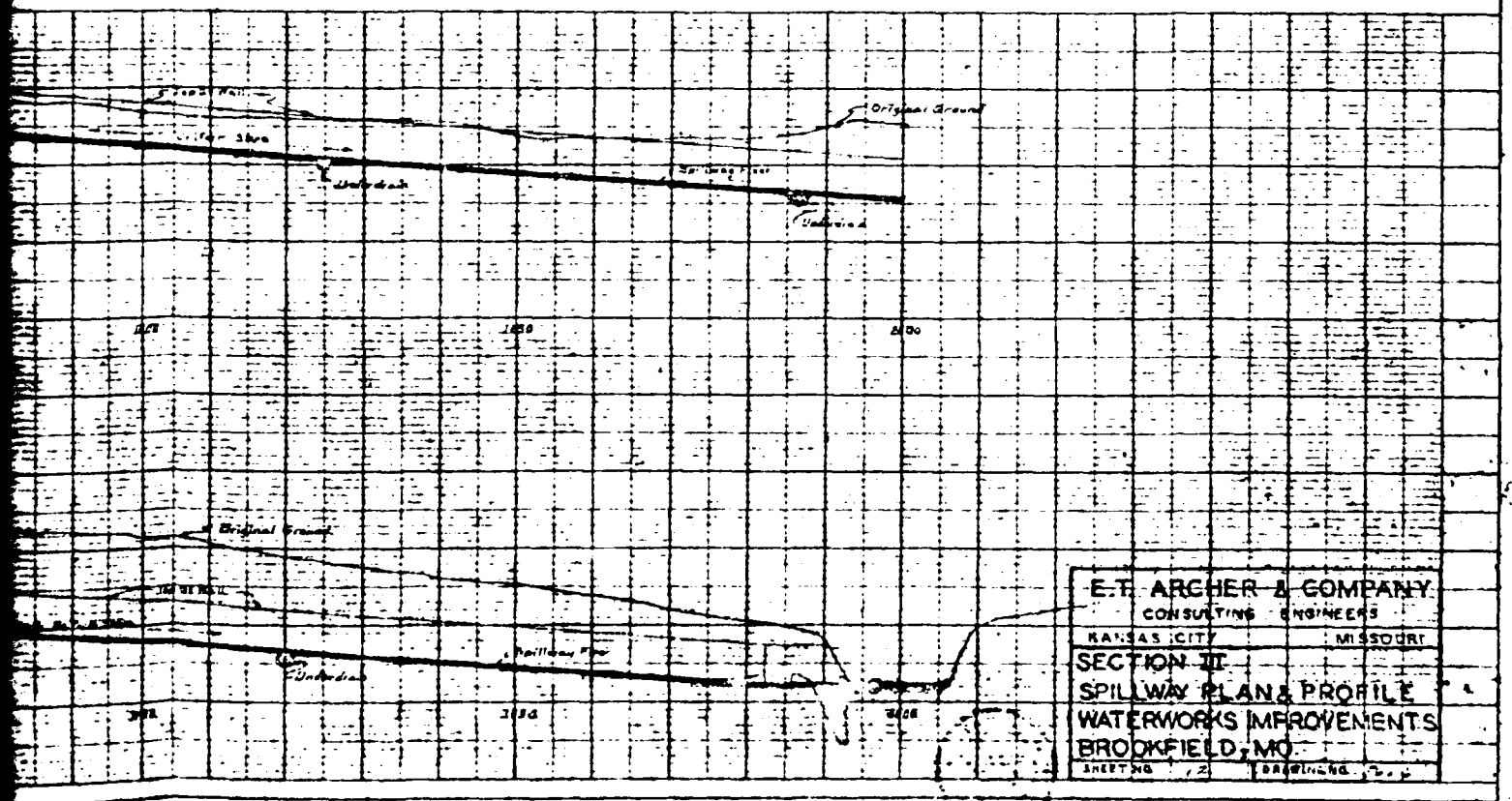


PLATE 6





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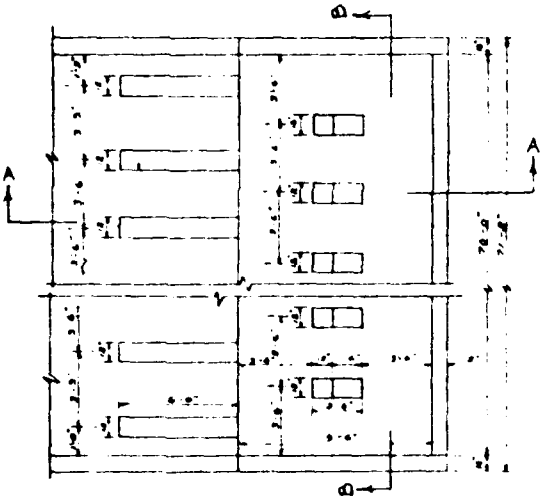
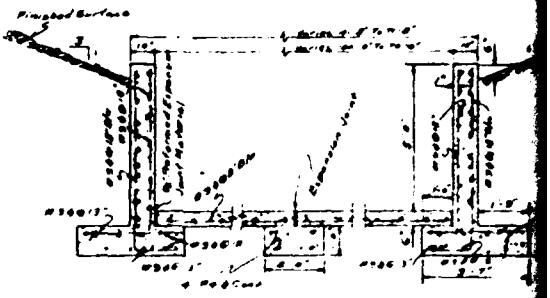
KANSAS CITY MISSOURI

SECTION III
SPILLWAY PLAN & PROFILE
WATERWORKS IMPROVEMENTS
BROOKFIELD, MO.

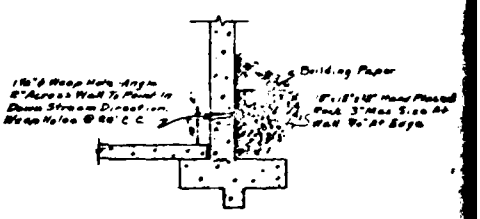
SHEET NO. 12 DRAWING NO. 7



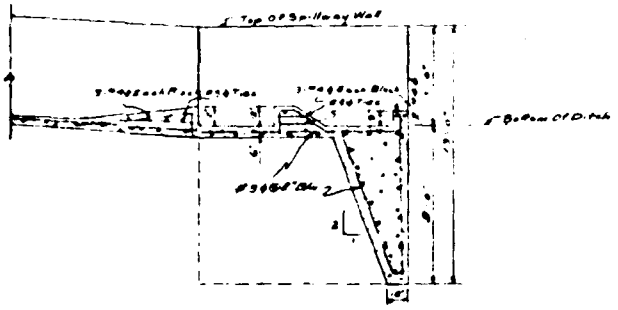
SPILLWAY TAILRACE - PLAN



TYPICAL SPILLWAY CROSS SECTION



WEEP HOLE DETAIL



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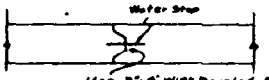
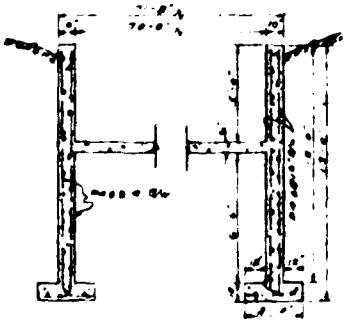


CONSTRUCTION JOINT DETAIL - WALLS & FLOOR SLAB



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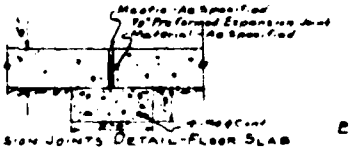
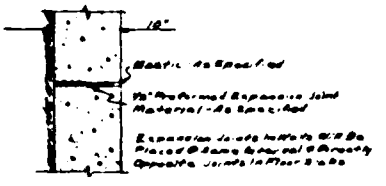
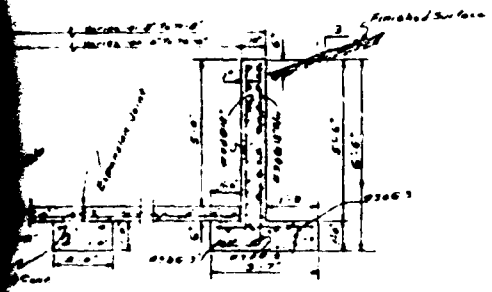


EXPANSION JOINTS DETAIL - FLOOR SLAB

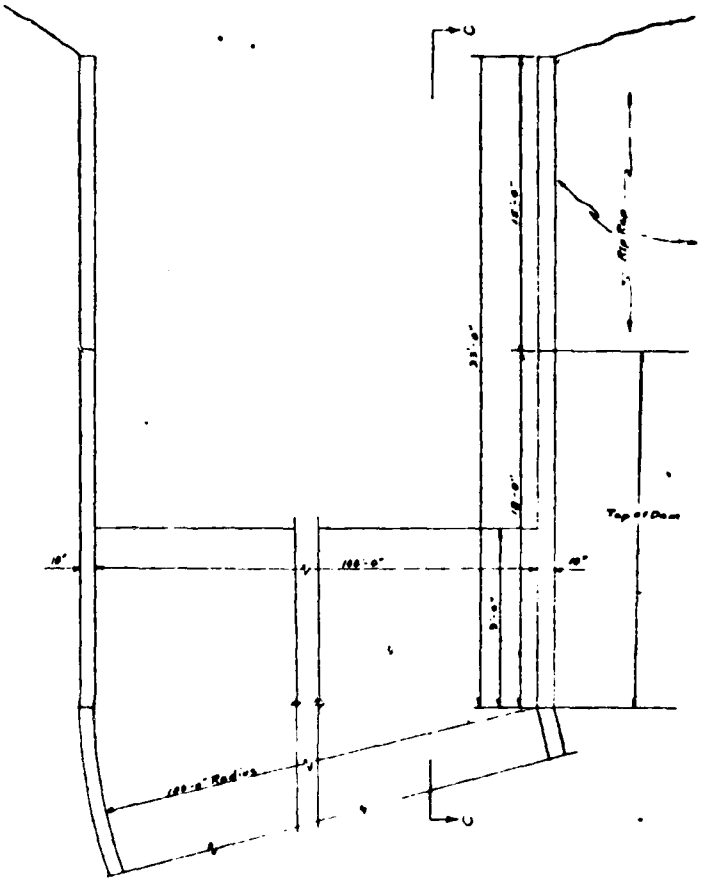


EXPANSION JOINTS DETAIL - WALLS

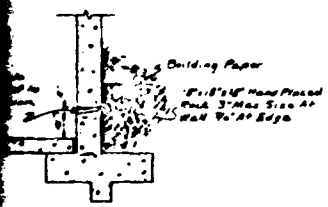
PLATE 7



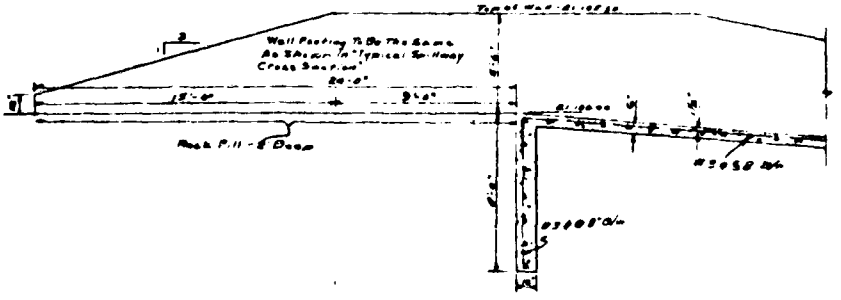
SPILLWAY CROSS SECTION



PLAN SPILLWAY CREST



WEEP HOLE DETAIL



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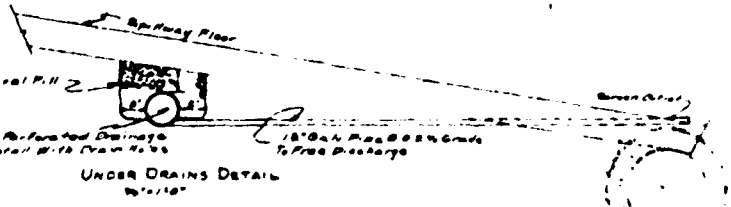

UNDER DRAINS DETAIL

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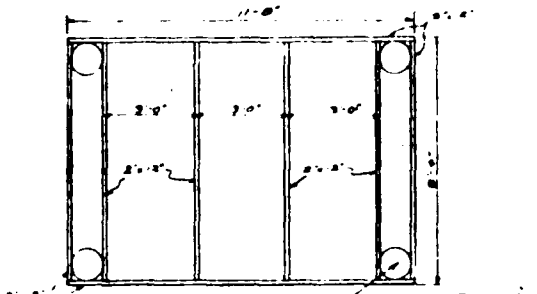
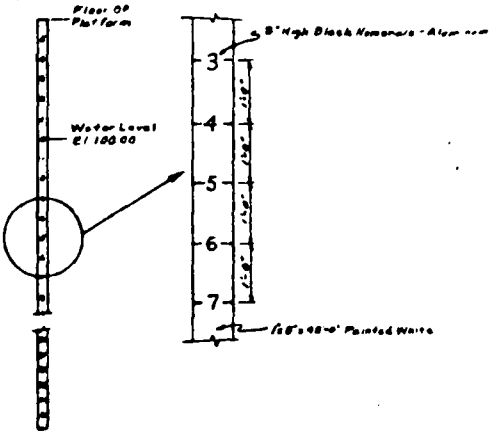
KANSAS CITY MISSOURI

SECTION III
SPILLWAY DETAILS
WATERWORKS IMPROVEMENTS
BROOKFIELD, MO.

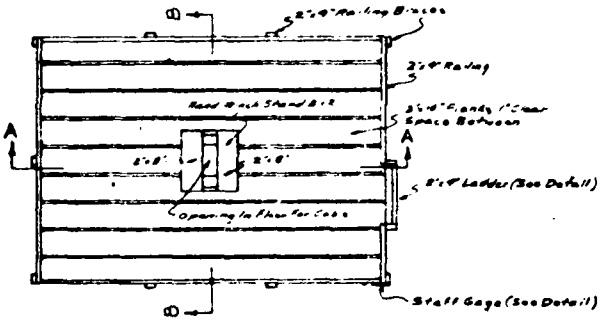
SHEET NO. — DRAWING NO. 5927



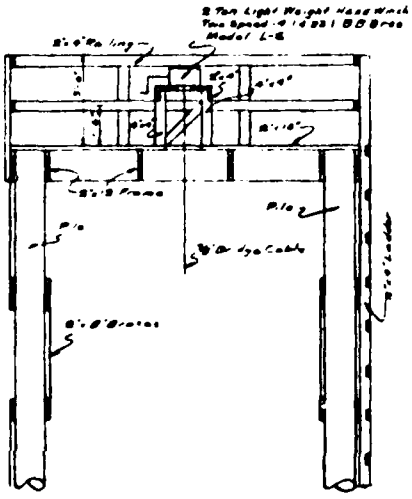
FRAMING PLAN



STAFF GAGE DETAIL



PLATFORM PLAN



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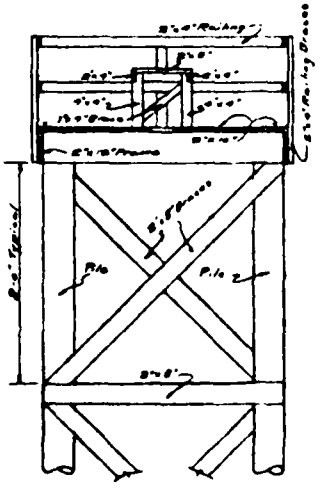

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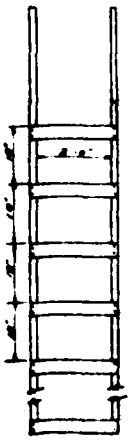
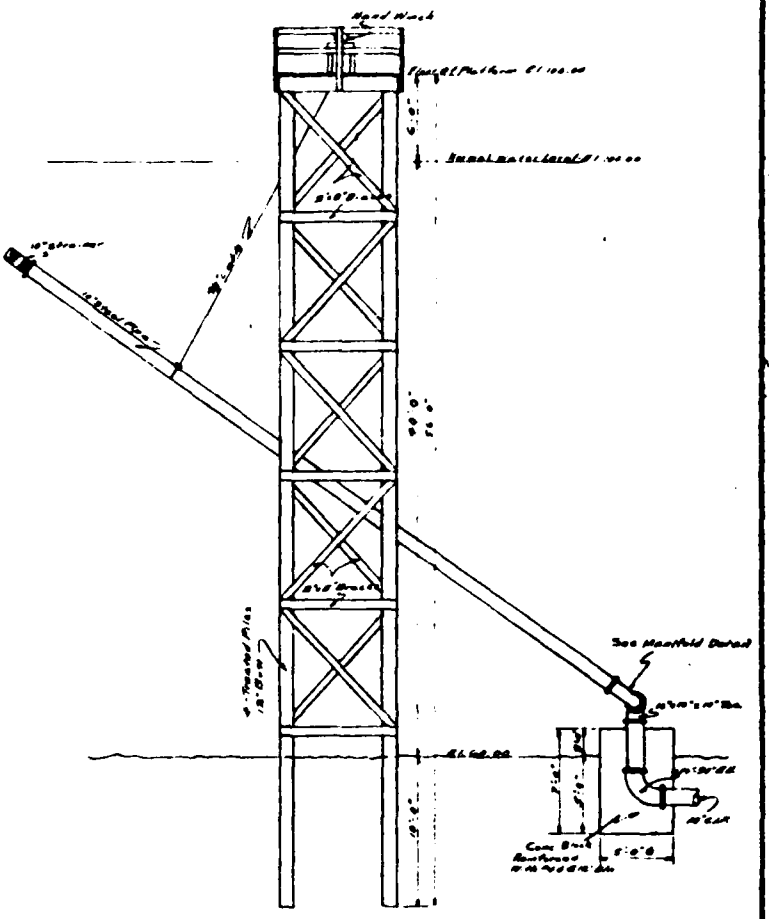
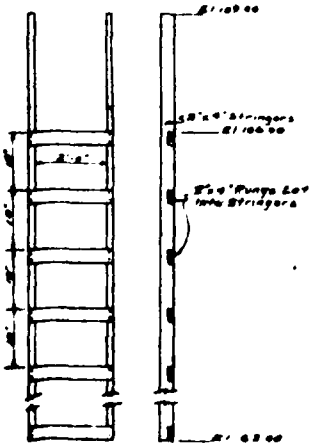


LADDER DETAIL

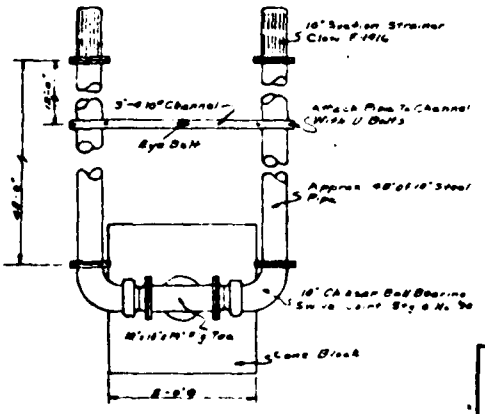
PLATE 8



ADJUSTABLE BOOM INTAKE STRUCTURE



LADDER DETAIL



INTAKE MANIFOLD DETAIL

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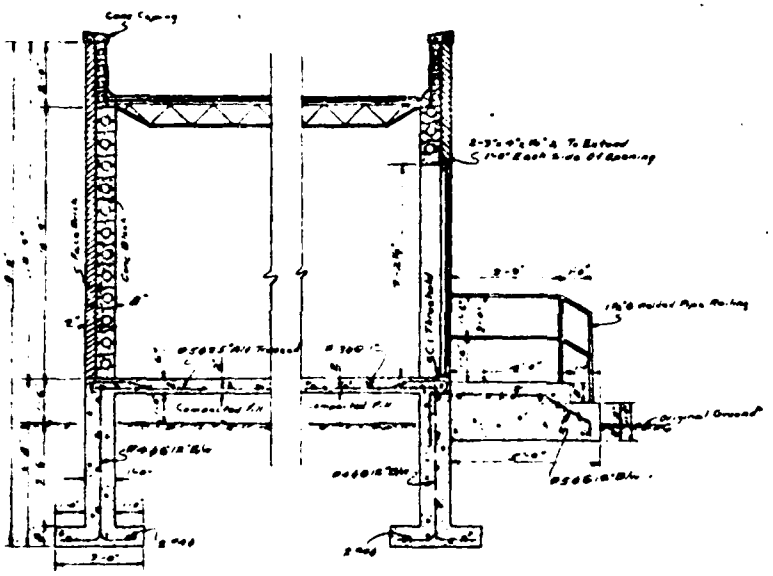
KANSAS CITY MISSOURI

SECTION IV
ADJUSTABLE INTAKE DETAILS
WATERWORKS IMPROVEMENTS
BROOKFIELD, MO.

SHEET NO. 39 DRAWING NO. 5939



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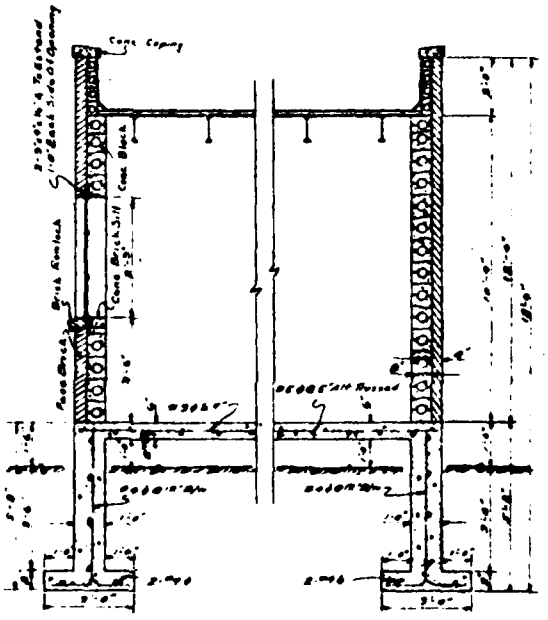
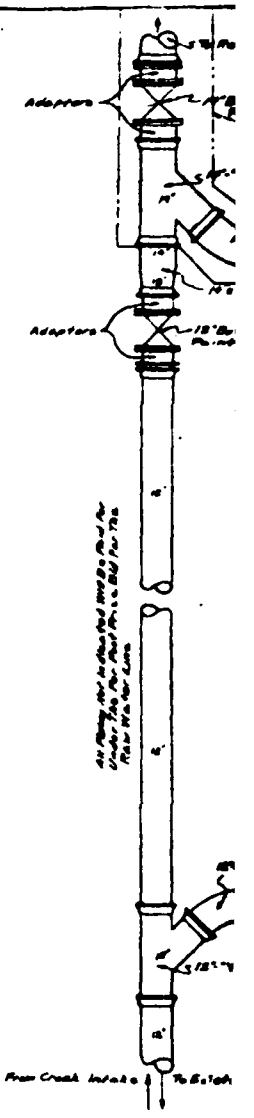
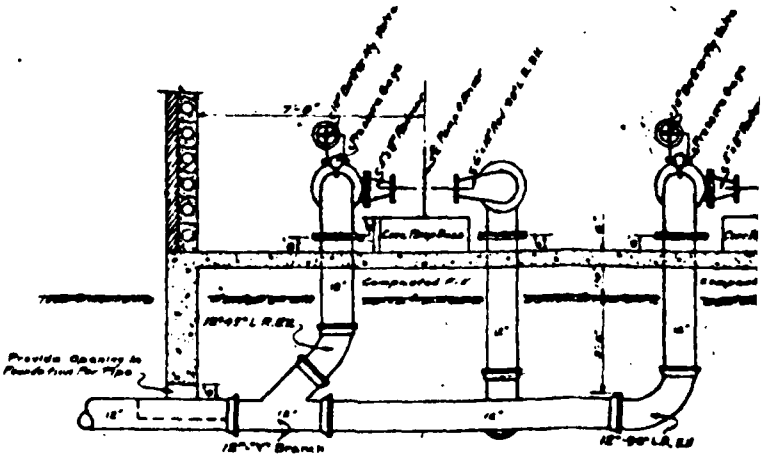


E F

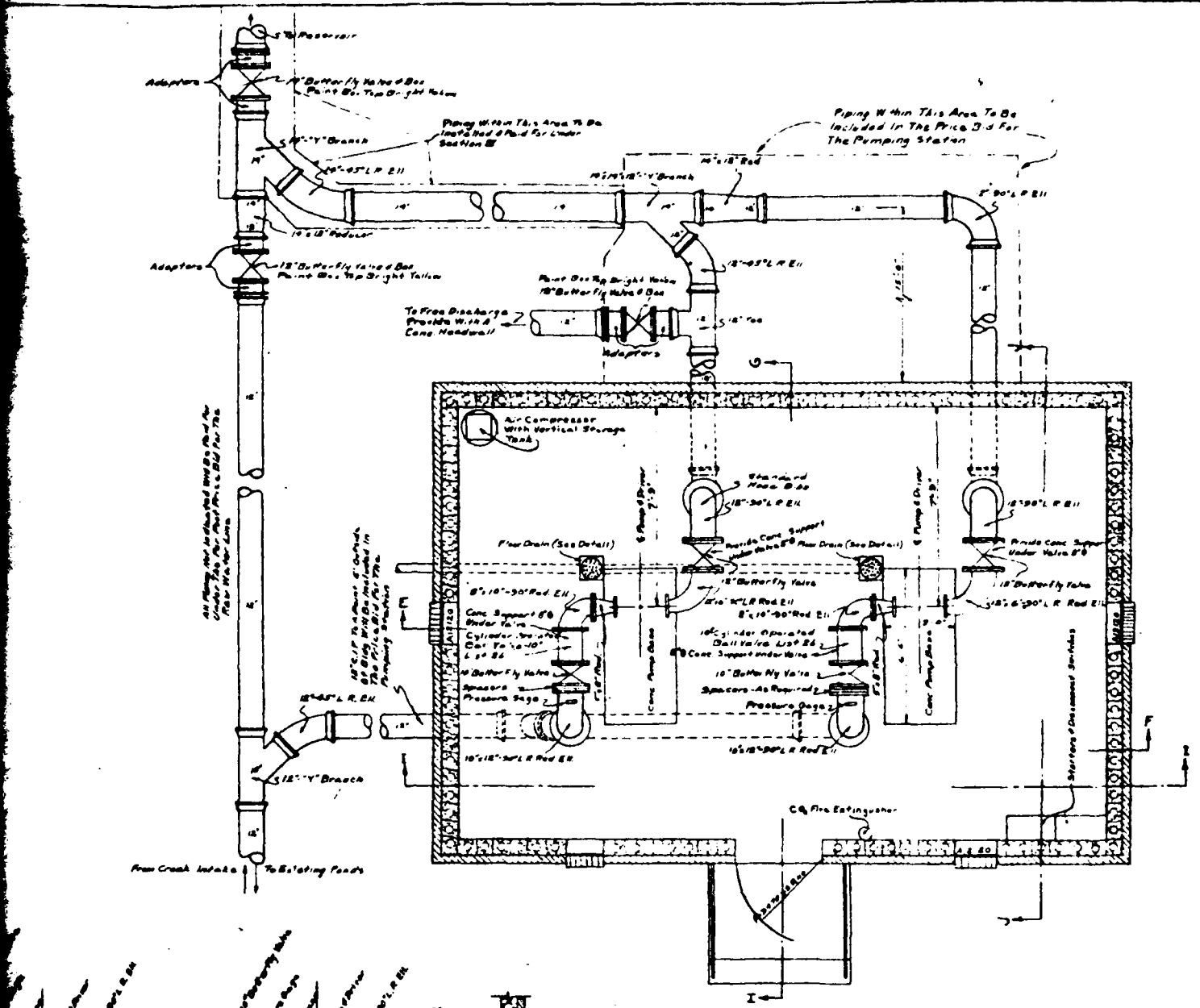
TYPICAL WALL SECTIONS

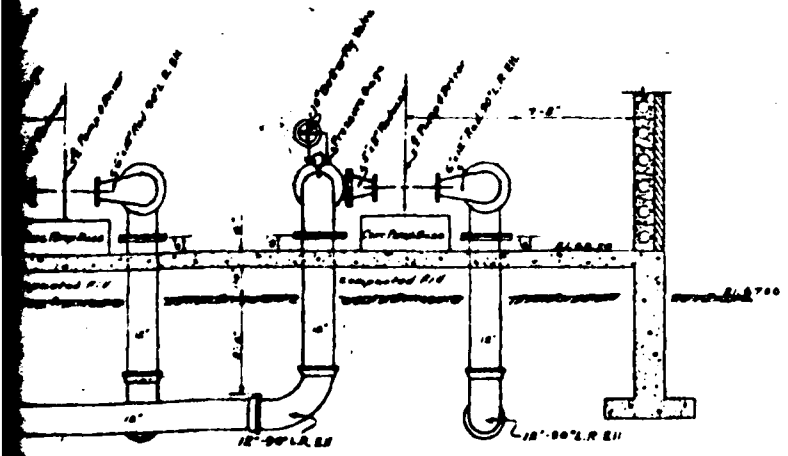




I-I

PLATE 9





I-I

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CONSULTING ENGINEERS
KANSAS CITY MISSOURI

SECTION IV
LAKE PUMPING STATION
WATERWORKS IMPROVEMENTS
BROOKFIELD, MO.

SHEET NO. 26 DRAWING NO. 5995

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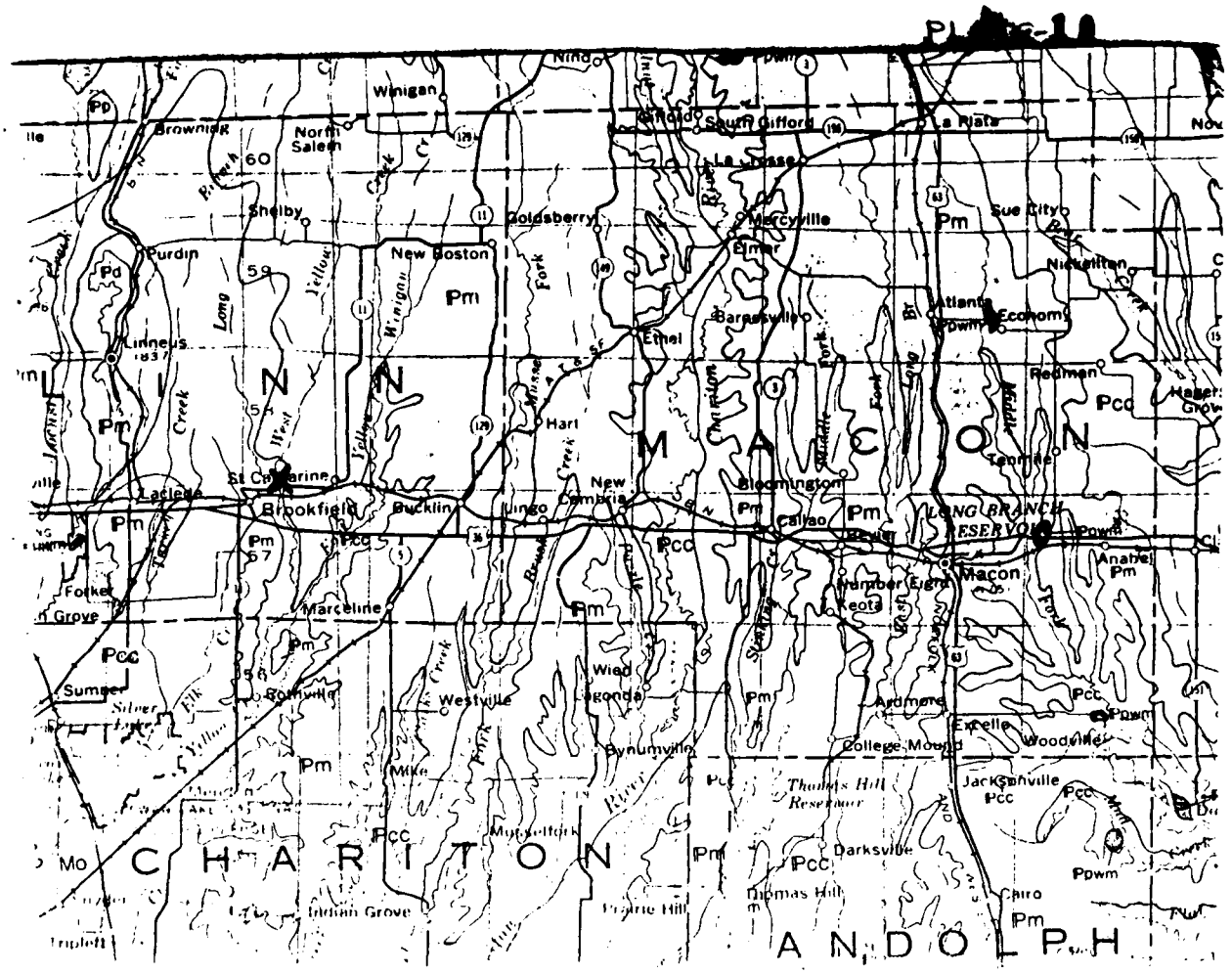


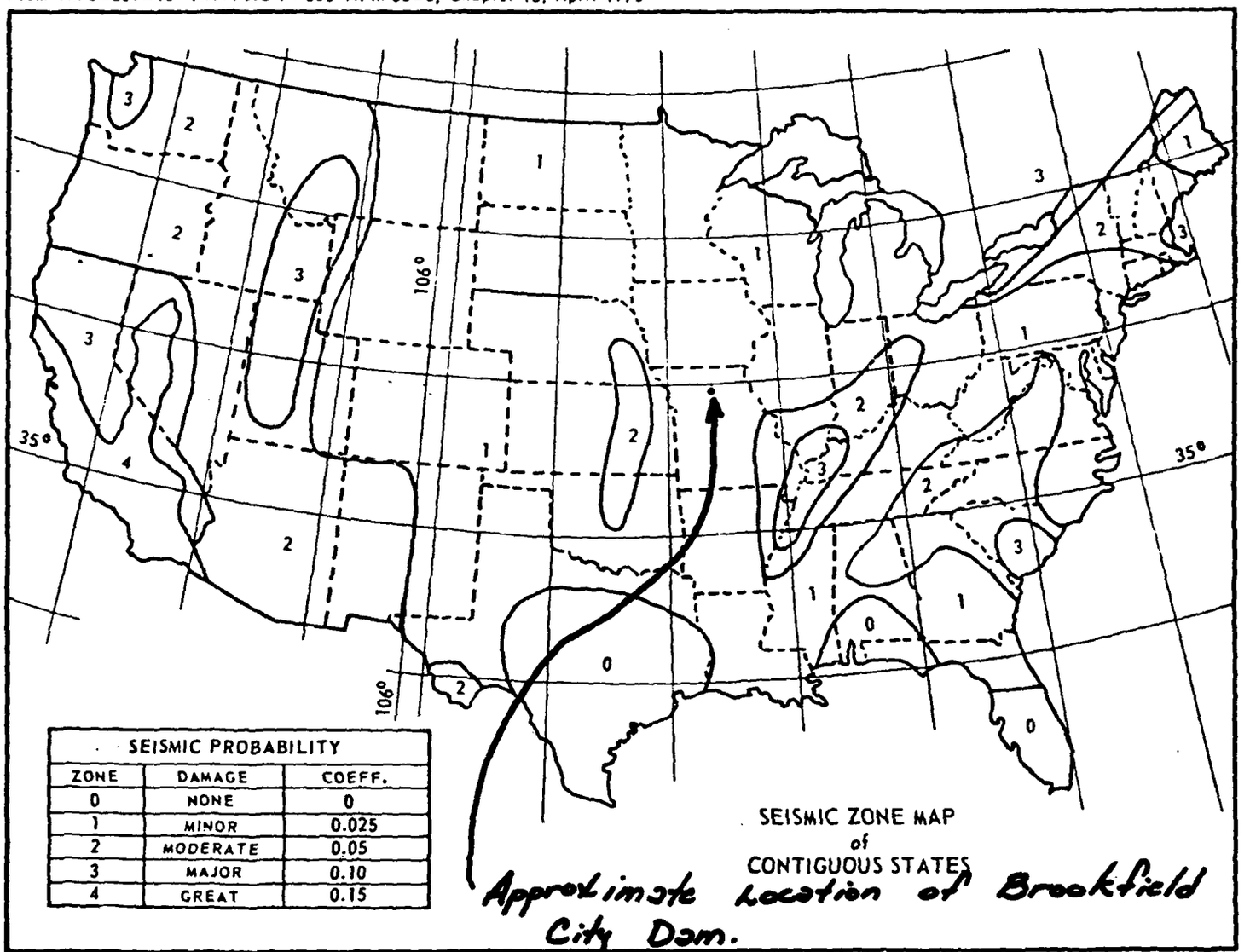
PENNSYLVANIAN
- Pm - MARMATON GROUP
- Pcc - CHEROKEE GROUP, CABANISS SUBGROUP

X - LOCATION OF DAM, MO. 10181

REFERENCE:
GEOLOGIC MAP OF MISSOURI
MISSOURI GEOLOGIC SURVEY
1979

GEOLOGIC MAP OF LINN COUNTY AND ADJACENT AREA

From TM 5-809-10 / NAVFAC P-355 / AFM 88-3, Chapter 13; April 1973



SEISMIC PROBABILITY		
ZONE	DAMAGE	COEFF.
0	NONE	0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

PLATE-11

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

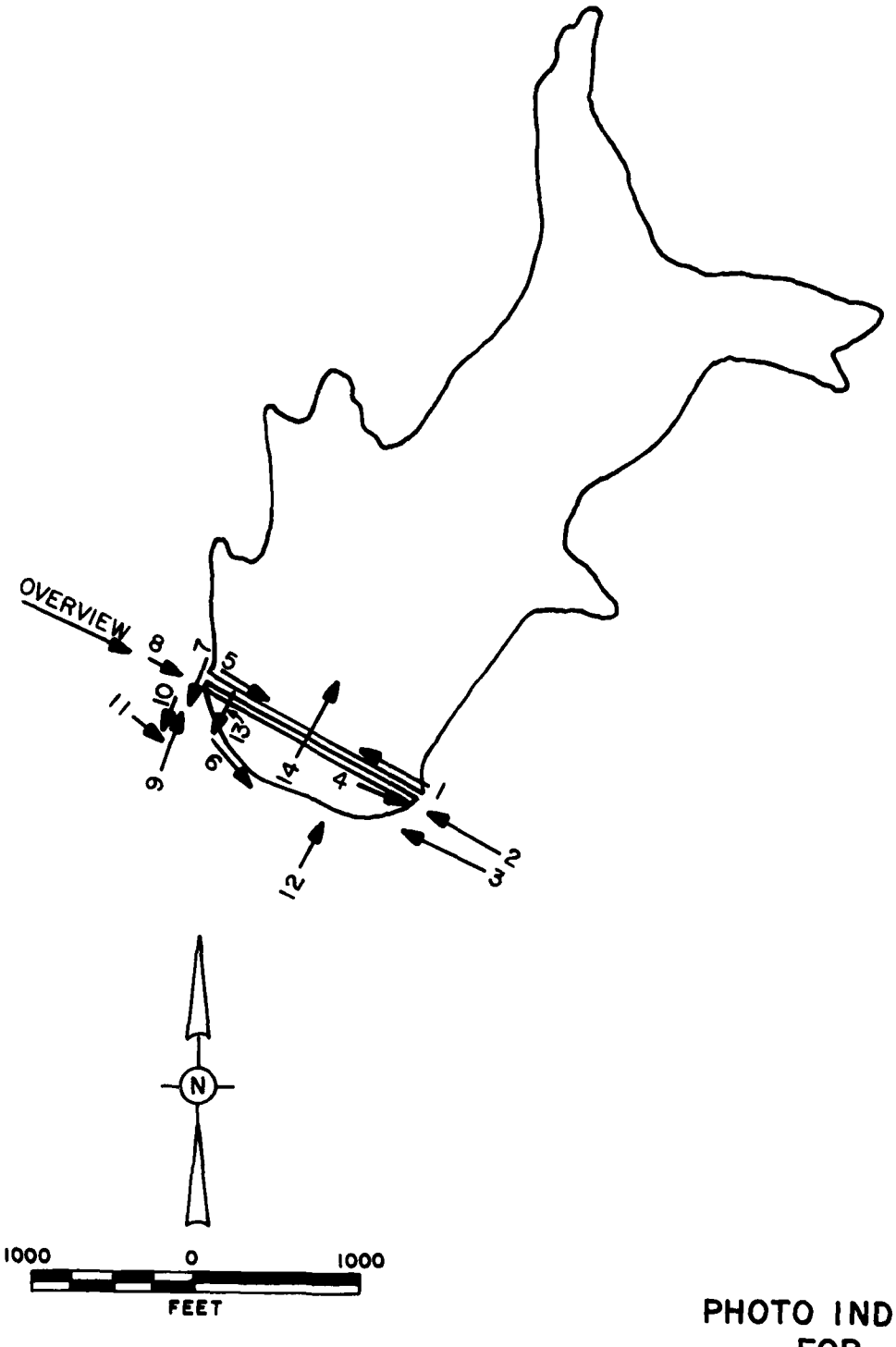


PHOTO INDEX
FOR
BROOKFIELD CITY DAM

Photo 1

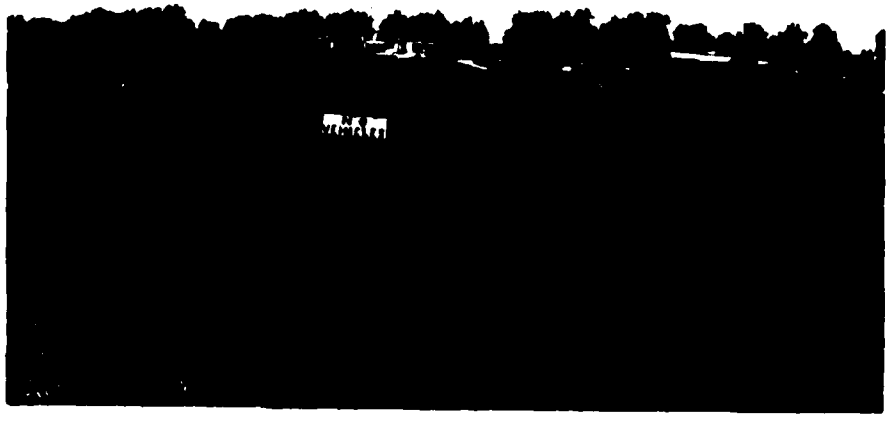


Photo 2

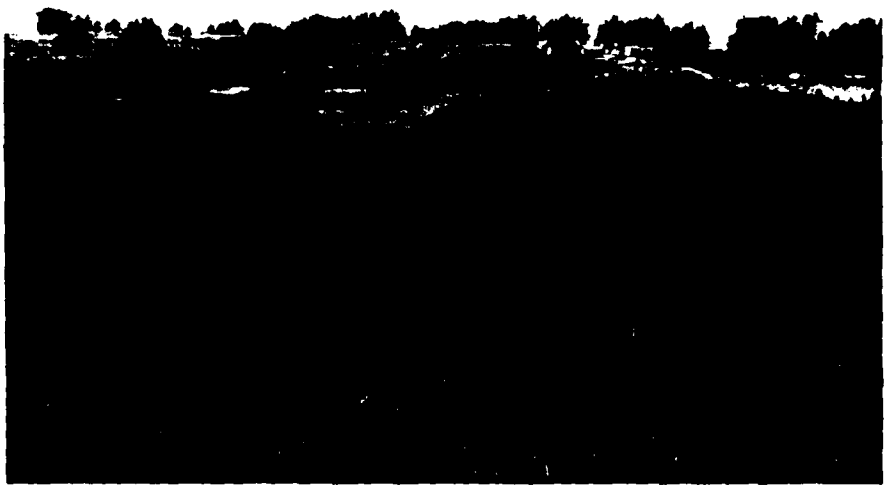


Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

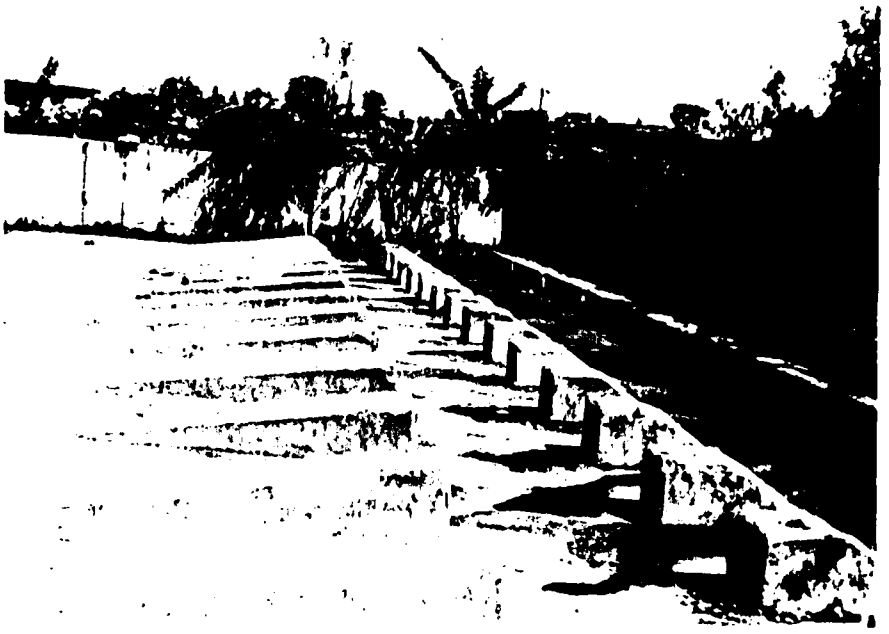


Photo 11

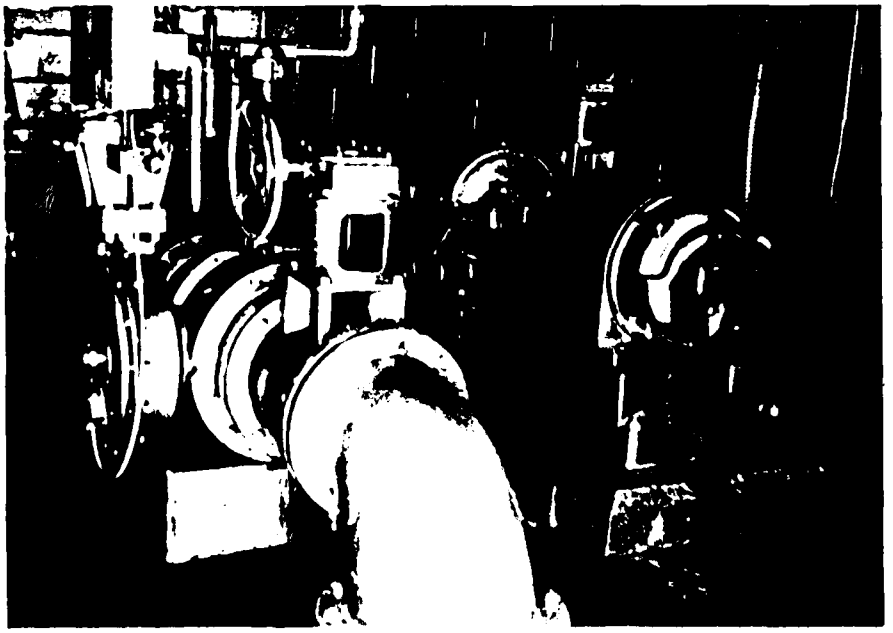


Photo 12

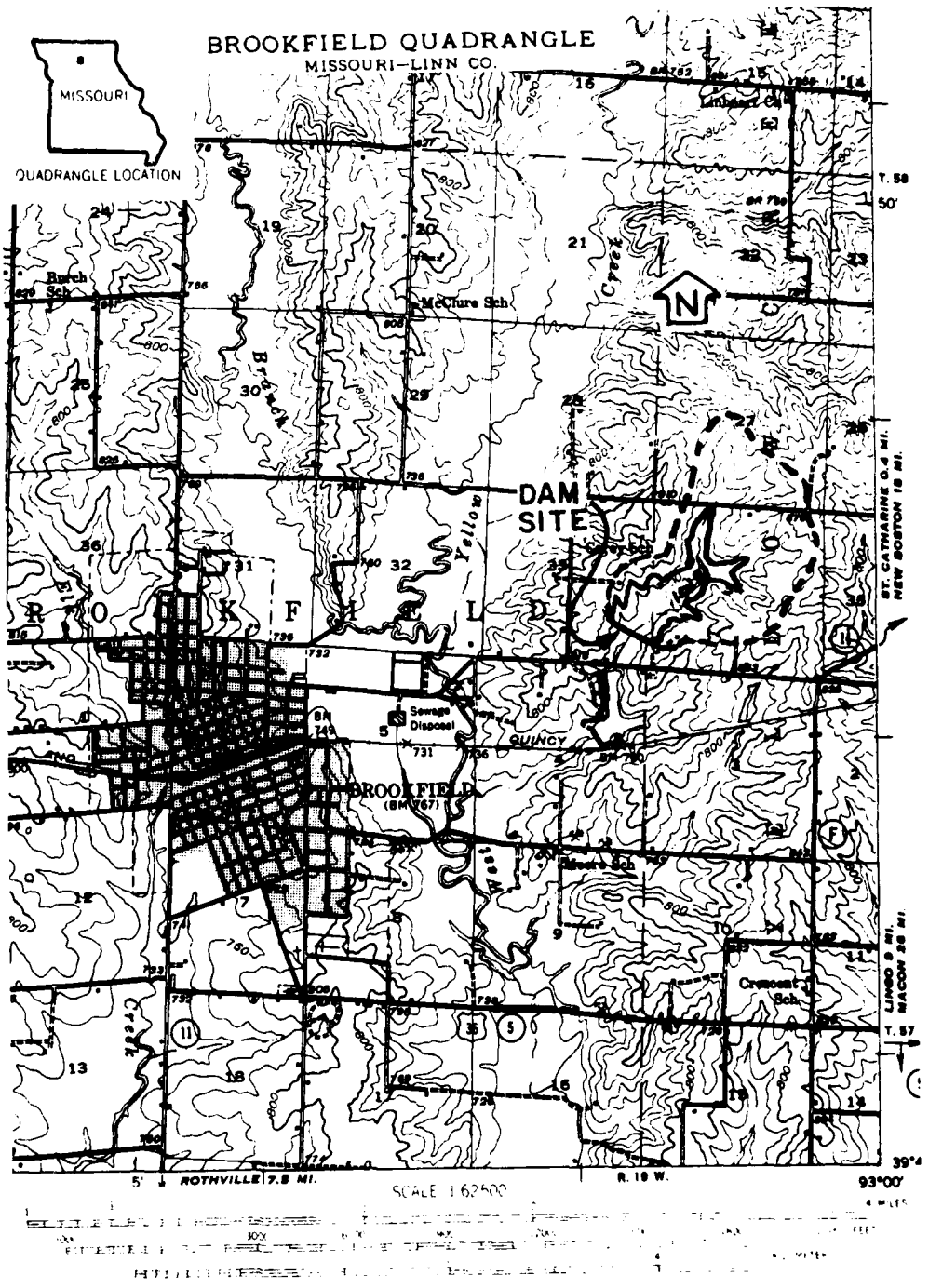
Photo 13

Photo 14

APPENDIX B

HYDROLOGIC COMPUTATIONS

PLATE I, APPENDIX B



DRAINAGE BOUNDARY — — — — —

BROOKFIELD CITY DAM (MO 10181)

DRAINAGE BASIN

B-2

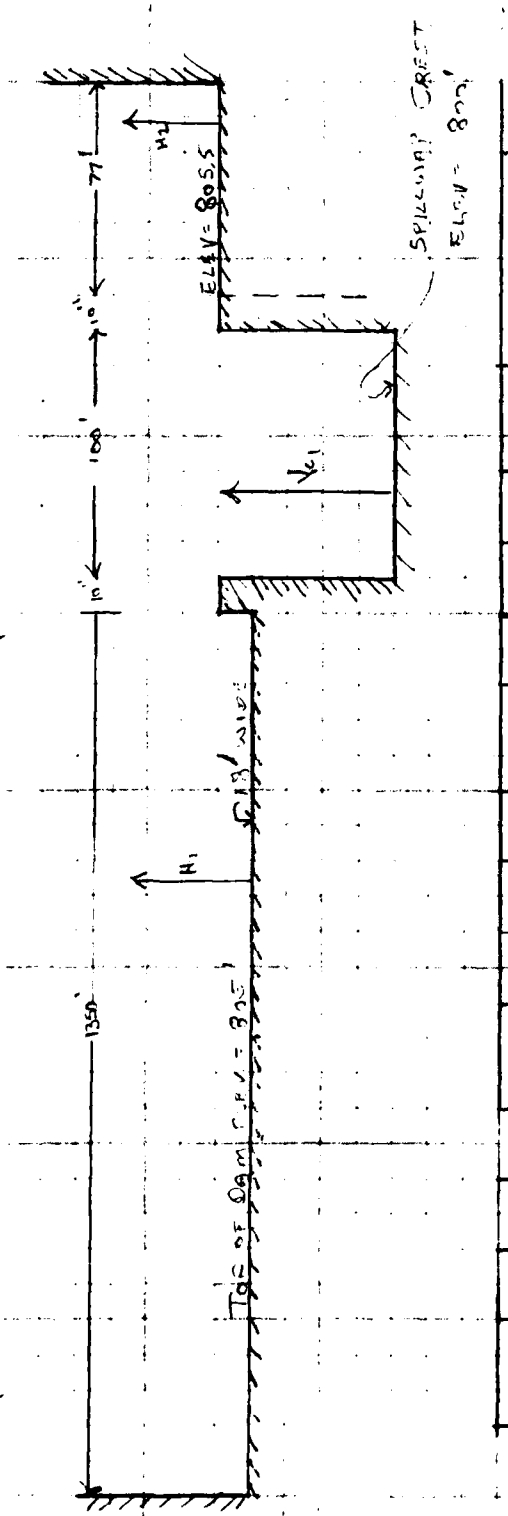
ECI-4

PRC ENGINEERING CONSULTANTS, INC.

Low Hazard Inspection — SHEET NO. 1 OF

Brookfield City Dam (# 10191) — JOB NO. 1240

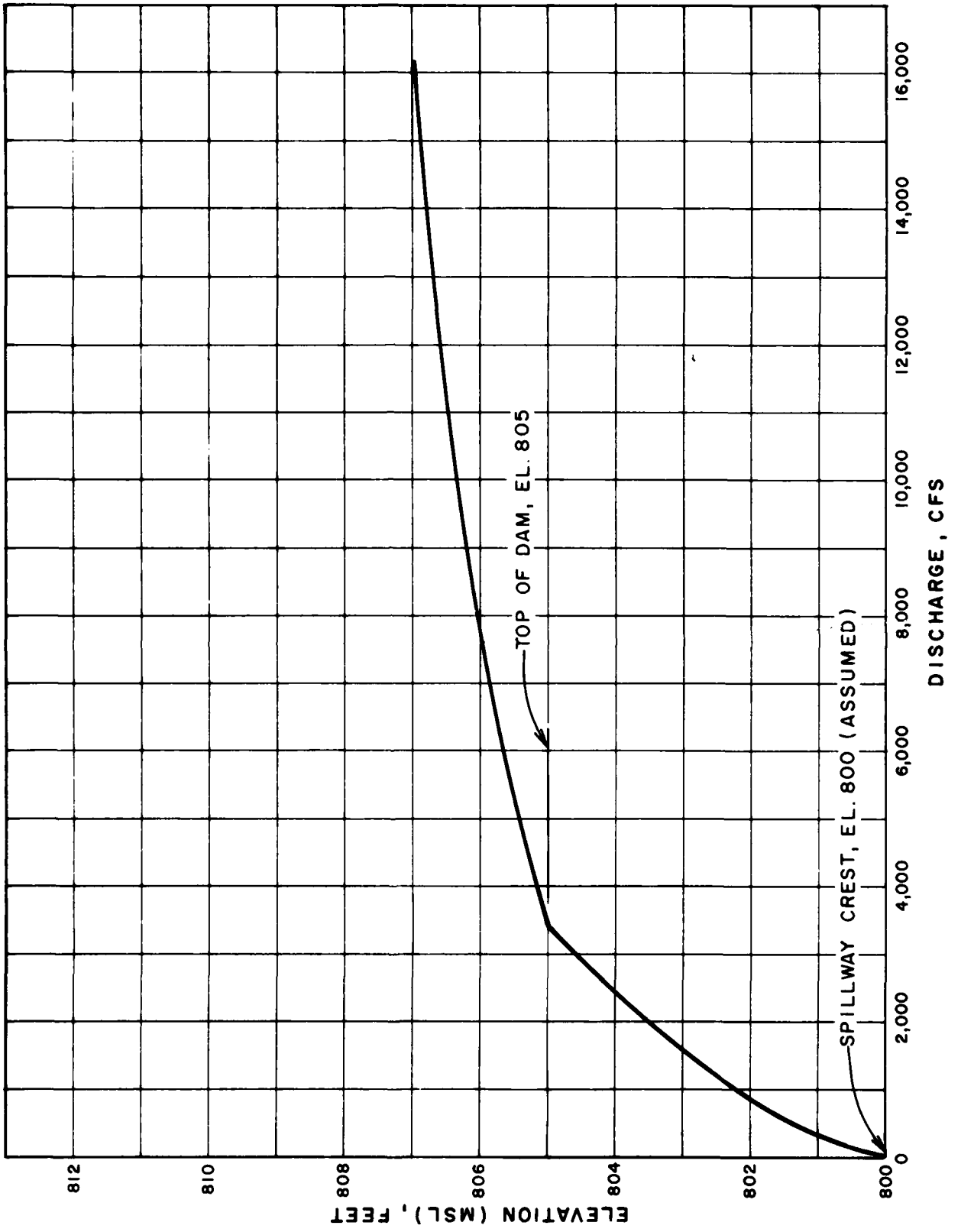
Spillway and Overtop Rating Curve — BY RAW KLBC DATE 1-5



U.S. W.S. Elev.	A_{t1}	Y_{or} (Spillway Crest = 800)	V_{t1} = $\sqrt{2g}$	Q_{f1} = $A_{t1} \cdot V_{t1}$	H_1	C_1	L_1	Q_1 = $C_1 L_1 H_1^{3/2}$	H_2	C_2	L_2	Q_2 = $C_2 L_2 H_2^{3/2}$	Q_t = $Q_1 + Q_2$
800		0		0	0								0
801	67	0.67	4.64	311	1.0	2.63	1350	3551	0.5	3.70	78.67	75	311
802	133	1.33	6.57	870	1.5	2.63		10042	1.5	2.63		380	870
804	267	2.67	9.27	2475	2.0	2.63							2475
805	333	3.33	10.35	3446	2.5	2.70							3446
805.5	367	3.67	10.97	3989	2.7	2.70							5278
806	400	4.0	11.85	4540	1.0	2.63							8166
807	467	4.67	12.26	5725	2.0	2.63							16147

B-3

PLATE 2



BROOKFIELD CITY DAM (MO. 10181)
SPILLWAY AND OVERTOP RATING CURVE

BROOKFIELD CITY DAM

RESERVOIR AREA CAPACITY

ELEVATION MSL (FT)	RESERVOIR SURFACE AREA (ACRES)	INCREMENTAL VOLUME (AC-FT)	TOTAL VOLUME (AC-FT)	REMARKS
765	0	0	0	ESTIMATED STREAMBED ELEVATION AT DAM
780	49	245	245	
785	66	286	531	
800	118	1361	1892	SPILLWAY CREST
805	141	647	2539	TOP OF DAM
820	209	2608	5147	

$\Delta V_1 = \frac{15}{3}(49) = 245$

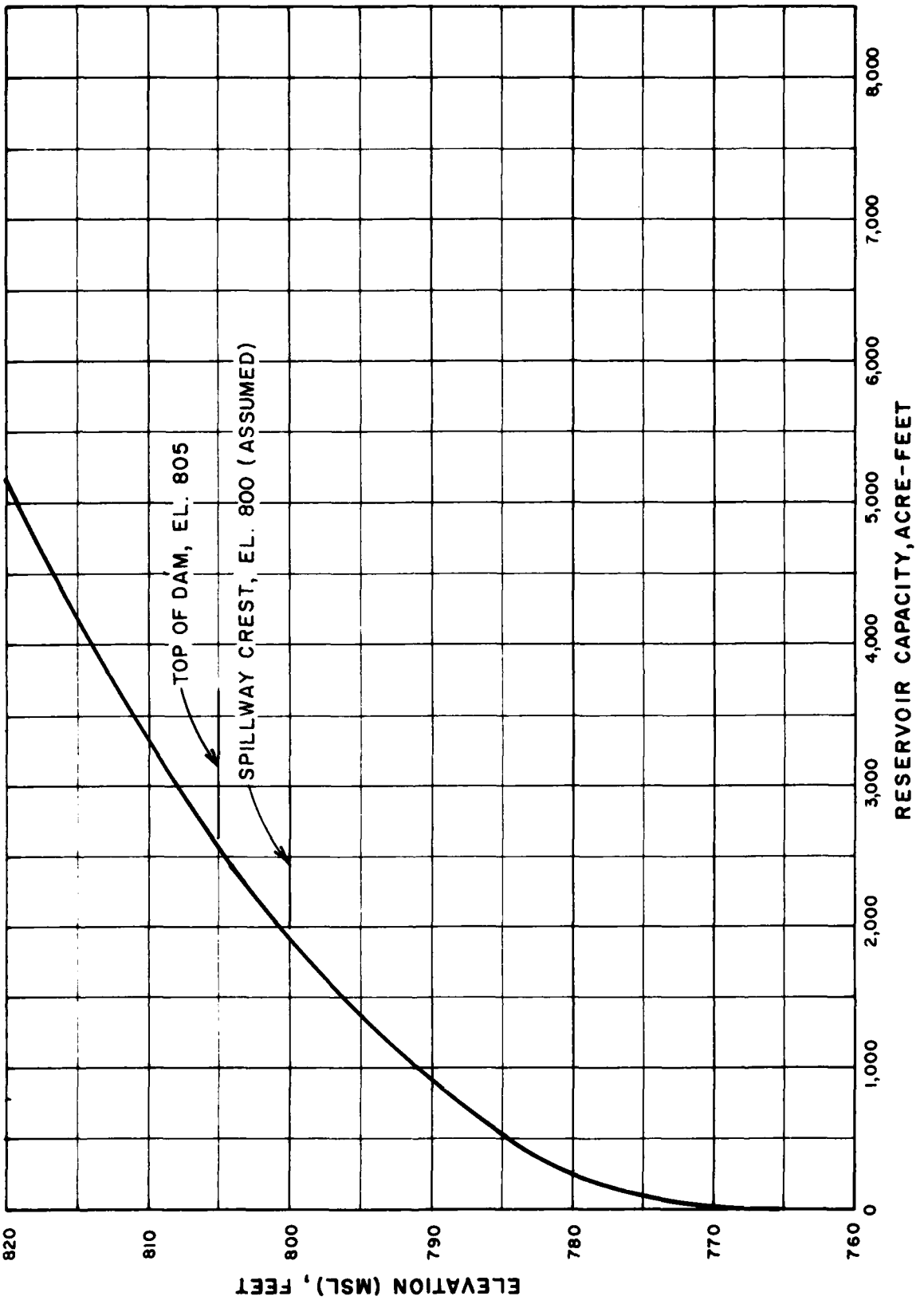
$\Delta V_2 = \frac{5}{3}(66+49+\sqrt{66\times49}) = 286$

$\Delta V_3 = \frac{15}{3}(118+66+\sqrt{118\times66}) = 1361$

$\Delta V_4 = \frac{5}{3}(141+118+\sqrt{141\times118}) = 647$

$\Delta V_5 = \frac{15}{3}(209+141+\sqrt{209\times141}) = 2608$

PART 3



R-6

BROOKFIELD CITY DAM (MO.10181)
RESERVOIR CAPACITY CURVE

EC-4 ENGINEERING CONSULTANTS, INC.

Dam Safety Inspection — SHEET NO. 1 OF
Missouri Dam (MO. 10181) — JOB NO. 1240-001
Probable Maximum Precipitation — BY JRW KLB DATE 8-17-7

DAM # MO 10181

DETERMINATION OF PMP

1.) DETERMINE DRAINAGE AREA OF BASIN

D.A. = 802 Ac

2.) DETERMINE PMP INDEX RAINFALL (200 SQ.MI., 24 HR. DURATION)

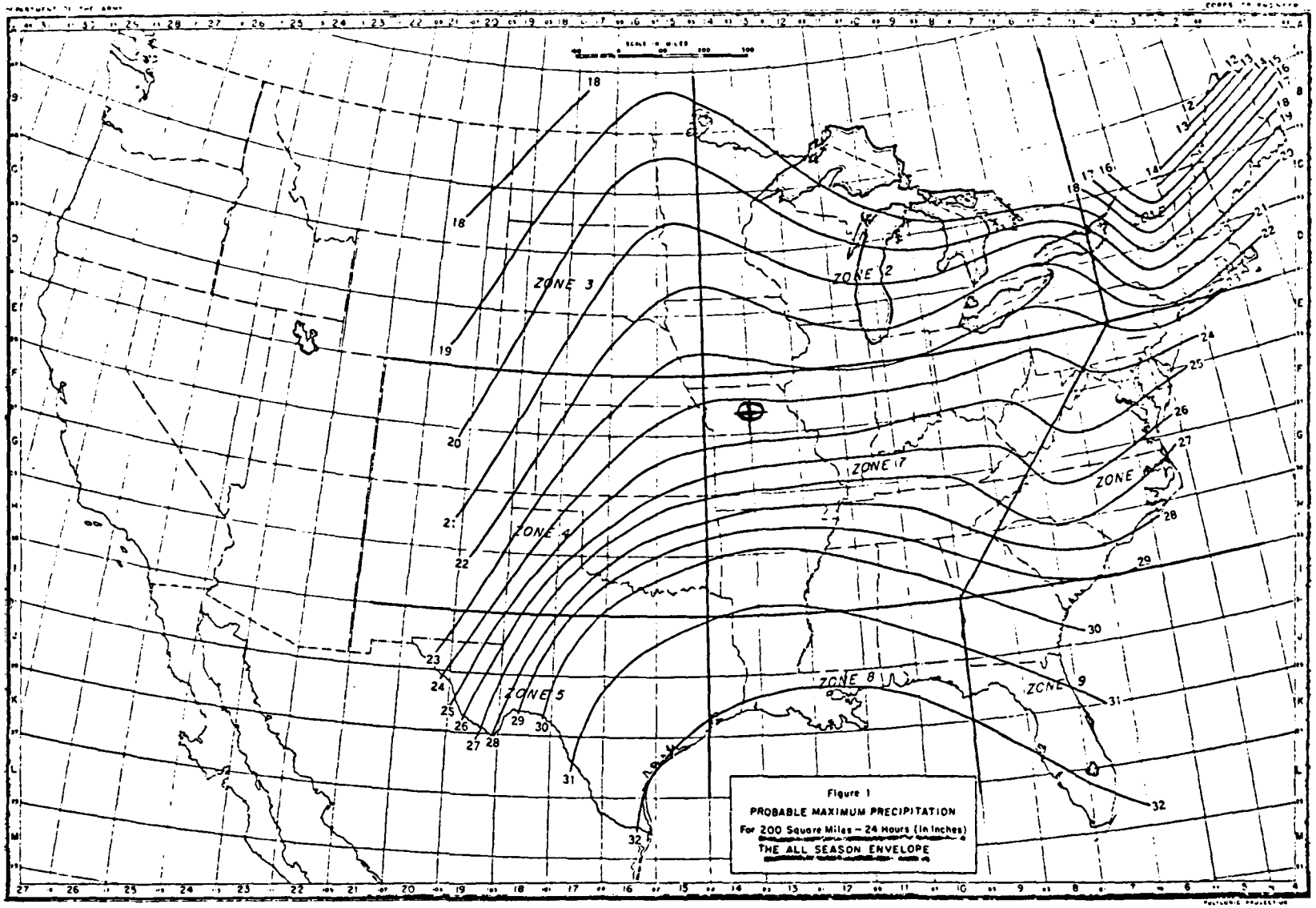
LOCATION OF CENTROID OF BASIN

LONG 93° 00' 53" } ⇒ PMP = 24.25
LAT 39° 48' 11"

3.) DETERMINE BASIN RAINFALL IN TERMS OF PERCENTAGE OF PMP INDEX RAINFALL FOR VARIOUS DURATIONS:

LOCATION LONG. 93° 00' 53"
LAT. 39° 48' 11"
⇒ ZONE 7

DURATION (HRS)	PERCENT OF INDEX RAINFALL	TOTAL RAINFALL (IN)	RAINFALL INCREMENTS	DURATION OF INCREMENTS
6	100	24.25	24.25	6
12	120	29.1	4.85	6
24	130	31.52	2.42	12



B-8

Missouri Dam (Mo. 10181)

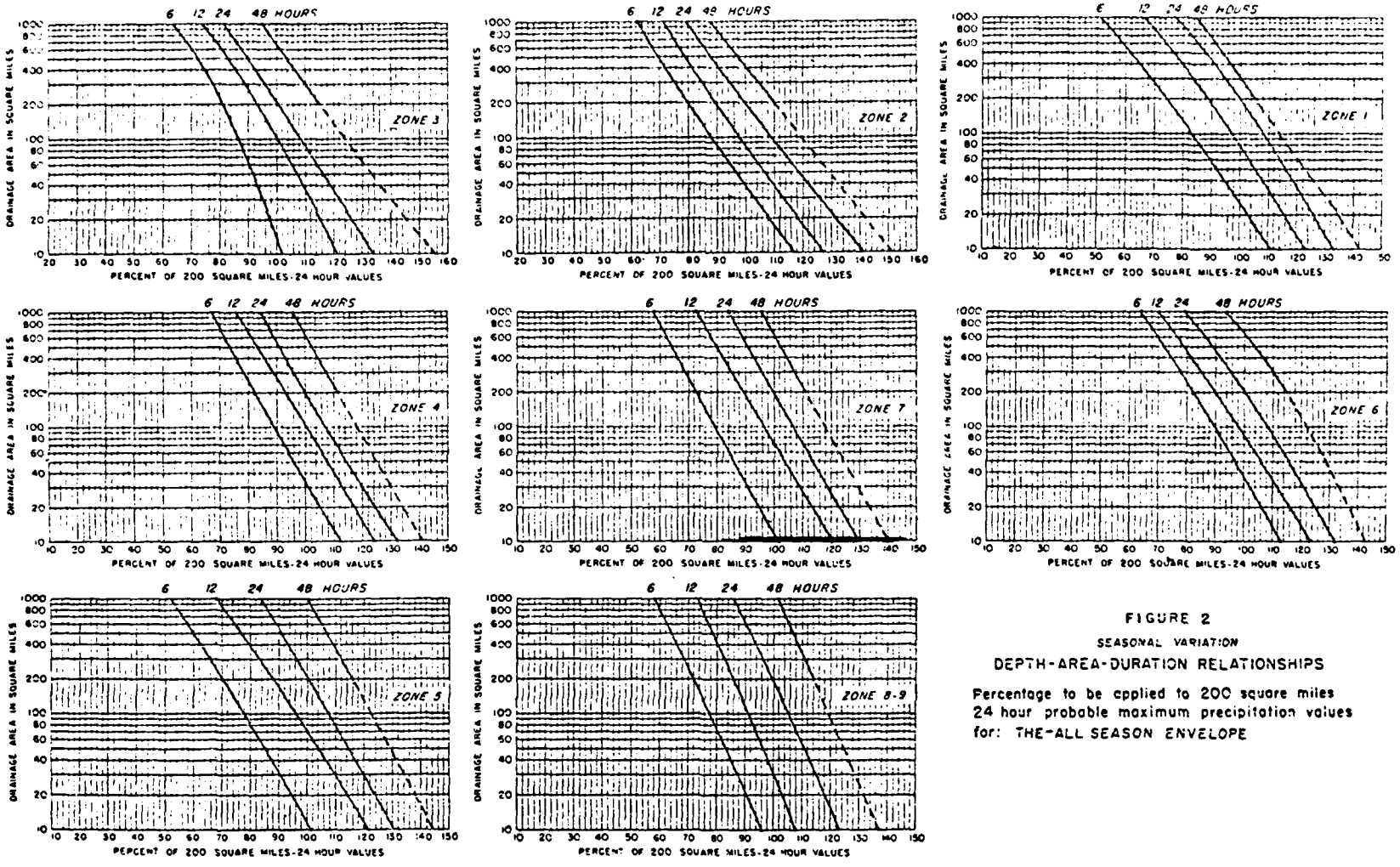


FIGURE 2

SEASONAL VARIATION

DEPTH-AREA-DURATION RELATIONSHIPS

Percentage to be applied to 200 square miles 24 hour probable maximum precipitation values for: THE ALL SEASON ENVELOPE

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION - Missouri — SHEET NO. 1 OF

BROOKFIELD City DAM (#10181) — JOB NO. 1240-001-1

UNIT HYDROGRAPH PARAMETERS — BY KLB (PRW) DATE 8-20

1. DRAINAGE AREA, A = 702 ACRES = 1.1 SQ. MI.

2. LENGTH OF STREAM = 0.48" × $\frac{62500}{12}$ = 2500 Ft = 0.47 mi.

3. ELEVATION AT DRAINAGE DIVIDE ALONG THE LONGEST STREAM H_1 = 870 Ft

4. RESERVOIR ELEVATION AT THE SPILLWAY CREST, H_2 = 800 Ft (ASSUMED)

5. DIFFERENCE IN ELEVATION, $\Delta H = H_1 - H_2 = 870 - 800 = 70$ Ft

6. AVERAGE SLOPE OF STREAM = $\frac{\Delta H}{L} = \frac{70}{2500} = 2.8\%$

7. TIME OF CONCENTRATION

a) By KIRPICH FORMULA:

$$T_c = \left(\frac{11.9 \times L^3}{\Delta H}\right)^{0.385} = \left(\frac{11.9 \times 0.47^3}{70}\right)^{0.385}$$

T_c = 0.21 HR

b) By VELOCITY ESTIMATE:

AVERAGE SLOPE = 2.8% ⇒ V = 3 FPS

$T_c = \frac{L}{V} = \frac{2500}{3 \times 3600}$ = 0.23 HR.

USE T_c = 0.21 HR

8. LAG TIME = 0.6 × T_c = 0.6 × 0.21 = 0.13 HR

9. UNIT DURATION = D ≤ $L_t/3$ = $\frac{0.13}{3}$ = 0.0433

USE D = 0.083 HR = 5 MIN

10. TIME TO PEAK, $T_p = \frac{D}{2} + L_t$ = 0.17 HR

11. PEAK DISCHARGE, $q_p = \frac{484 \cdot A}{T_p} = \frac{484 \times (1.10)}{0.17}$

q_p = 3132 CFS

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION - MISSOURI SHEET NO. 1 OF

BROOKFIELD CITY DAM (#10181) JOB NO. 1240-011

SOIL GROUP AND CURVE NUMBER DETERMINATION BY KLB DATE 8-1

BROOKFIELD CITY DAM (#10181)

HYDROLOGIC SOIL GROUP AND CURVE NUMBER

1. WATERSHED SOILS IN THE BASIN CONSIST OF GROUP C, AND D SOILS, WITH GROUP C BEING PREDOMINANT. ASSUME GROUP C SOILS FOR HYDROLOGIC PURPOSES OVER THE ENTIRE WATERSHED.

2. THIS WATERSHED IS PRIMARILY AGRICULTURAL WITH PASTURE AND RANGE LAND COVERING MOST OF THE BASIN. ASSUME THE HYDROLOGIC CONDITION OF THIS WATERSHED IS "FAIR".

THUS CN = 79 (PASTURE AND RANGE)

WITH AMC II

$\Rightarrow$ CN = 91 WITH AMC III

HEC1DB INPUT DATA

```
**************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
  LAST MODIFICATION  26 FEB 79
**************************************

A1                          DAM SAFETY INSPECTION - MISSOURI
A2                             BROOKFIELD CITY DAM (MO.10111)
A3                             PMF AND 50 PERCENT PMF
B     300       0       5       0       0       0       0       0       0       0
B1      5
J       1       2       1
J1      1      .5
K       0   12141
K1  INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS
M       1       2     1.1             1.1       1
P           24.25     100     120     130
T                                                      -1     -91
W2            .13
X                       1
K       1
K1  ROUTE HYDROGRAPH THROUGH BROOKFIELD CITY DAM
Y                               1       1
Y1                                                   -.00      -1
Y4    800     801     802     804     805   805.5     806     807
Y5      0     311     870    2475    3446    5278    8166   16147
$S      0     245     531    1492    2539    5147
$E    765     780     785     800     805     823
$$  800.0
$D    805
K      99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1014-1
ROUTE HYDROGRAPH TO
END OF NETWORK

INFLOW PMF AND ONE-HALF PMF HYDROGRAPHS

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
LAST MODIFICATION  26 FEB 79
**********

RUN DATE= 79/09/28.
TIME= 07.08.12.
```

DAM SAFETY INSPECTION - MISSOURI
BROOKFIELD CITY DAM (MO.10181)
PMF AND 50 PERCENT PMF

JOB SPECIFICATION

NO	NRS	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	5	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 2 LRTIO= 1

RTIOS= 1.00 .50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS

IST	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10181	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	1.10	0.00	1.10	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PXS	R6	R12	R24	R48	R72	R96
0.00	24.25	100.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
1	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-91.00	0.00	0.00

CURVE NO = -91.00 WETNESS = -1.00 EFFECT CN = 91.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .15

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

TIME INCREMENT TOO LARGE--(NH2 IS GT LAG/2)

UNIT HYDROGRAPH 10 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .15 VOL= 1.00

1391. 225. 963. 441. 201. 91. 42. 20. 5.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.
1.01	.10	2	.01	0.00	.01	0.
1.01	.15	3	.01	0.00	.01	0.
1.01	.20	4	.01	0.00	.01	0.
1.01	.25	5	.01	0.00	.01	0.
1.01	.30	6	.01	0.00	.01	0.
1.01	.35	7	.01	0.00	.01	0.
1.01	.40	8	.01	.00	.01	1.
1.01	.45	9	.01	0.00	.01	0.
1.01	.50	10	.01	0.00	.01	0.
1.01	.55	11	.01	.00	.01	0.
1.01	1.00	12	.01	0.00	.01	0.
1.01	1.05	13	.01	0.00	.01	0.
1.01	1.10	14	.01	0.00	.01	0.
1.01	1.15	15	.01	.00	.01	0.
1.01	1.20	16	.01	.00	.01	0.
1.01	1.25	17	.01	.00	.01	0.
1.01	1.30	18	.01	.00	.01	0.
1.01	1.35	19	.01	.00	.01	0.
1.01	1.40	20	.01	.00	.01	0.
1.01	1.45	21	.01	.00	.01	10.
1.01	1.50	22	.01	.00	.01	14.
1.01	1.55	23	.01	.00	.01	17.
1.01	2.00	24	.01	.00	.01	19.
1.01	2.05	25	.01	.00	.01	22.
1.01	2.10	26	.01	.00	.01	24.
1.01	2.15	27	.01	.00	.01	26.
1.01	2.20	28	.01	.00	.01	29.
1.01	2.25	29	.01	.00	.01	30.
1.01	2.30	30	.01	.00	.01	32.
1.01	2.35	31	.01	.00	.01	34.
1.01	2.40	32	.01	.00	.01	36.
1.01	2.45	33	.01	.00	.01	38.
1.01	2.50	34	.01	.00	.01	39.
1.01	2.55	35	.01	.01	.01	41.
1.01	3.00	36	.01	.01	.01	43.
1.01	3.05	37	.01	.01	.01	44.
1.01	3.10	38	.01	.01	.01	46.
1.01	3.15	39	.01	.01	.01	47.
1.01	3.20	40	.01	.01	.01	48.
1.01	3.25	41	.01	.01	.01	50.
1.01	3.30	42	.01	.01	.01	51.
1.01	3.35	43	.01	.01	.01	52.
1.01	3.40	44	.01	.01	.01	54.
1.01	3.45	45	.01	.01	.01	55.
1.01	3.50	46	.01	.01	.01	56.
1.01	3.55	47	.01	.01	.01	57.
1.01	4.00	48	.01	.01	.01	59.
1.01	4.05	49	.01	.01	.01	59.
1.01	4.10	50	.01	.01	.01	60.
1.01	4.15	51	.01	.01	.01	61.
1.01	4.20	52	.01	.01	.01	62.
1.01	4.25	53	.01	.01	.01	63.
1.01	4.30	54	.01	.01	.01	64.
1.01	4.35	55	.01	.01	.01	65.
1.01	12.35	151	.20	.20	.00	1682.
1.01	12.40	152	.20	.20	.00	1689.
1.01	12.45	153	.20	.20	.00	1693.
1.01	12.50	154	.20	.20	.00	1695.
1.01	12.55	155	.20	.20	.00	1697.
1.01	13.00	156	.20	.20	.00	1698.
1.01	13.05	157	.24	.24	.00	1754.
1.01	13.10	158	.24	.24	.00	1879.
1.01	13.15	159	.24	.24	.00	1971.
1.01	13.20	160	.24	.24	.00	2010.
1.01	13.25	161	.24	.24	.00	2029.
1.01	13.30	162	.24	.24	.00	2038.
1.01	13.35	163	.24	.24	.00	2043.
1.01	13.40	164	.24	.24	.00	2045.
1.01	13.45	165	.24	.24	.00	2047.
1.01	13.50	166	.24	.24	.00	2048.
1.01	13.55	167	.24	.24	.00	2048.
1.01	14.00	168	.24	.24	.00	2049.
1.01	14.05	169	.30	.30	.00	2134.
1.01	14.10	170	.30	.30	.00	2321.
1.01	14.15	171	.30	.30	.00	2458.
1.01	14.20	172	.30	.30	.00	2516.
1.01	14.25	173	.30	.30	.00	2544.
1.01	14.30	174	.30	.30	.00	2557.
1.01	14.35	175	.30	.30	.00	2563.
1.01	14.40	176	.30	.30	.00	2566.
1.01	14.45	177	.30	.30	.00	2568.
1.01	14.50	178	.30	.30	.00	2568.
1.01	14.55	179	.30	.30	.00	2569.
1.01	15.00	180	.30	.30	.00	2569.
1.01	15.05	181	.34	.34	.00	2605.
1.01	15.10	182	.37	.37	.00	3093.
1.01	15.15	183	.37	.37	.00	3587.
1.01	15.20	184	.55	.55	.00	3153.
1.01	15.25	185	.64	.64	.00	3977.
1.01	15.30	186	1.57	1.06	.00	6013.
1.01	15.35	187	2.58	2.57	.01	10686.
1.01	15.40	188	1.01	1.01	.00	13009.
1.01	15.45	189	.65	.64	.00	11793.
1.01	15.50	190	.55	.55	.00	8419.
1.01	15.55	191	.37	.37	.00	6192.
1.01	16.00	192	.37	.37	.00	4665.
1.01	16.05	193	.28	.28	.00	3699.
1.01	16.10	194	.28	.28	.00	3061.
1.01	16.15	195	.28	.28	.00	2695.
1.01	16.20	196	.28	.28	.00	2505.
1.01	16.25	197	.28	.28	.00	2452.
1.01	16.30	198	.28	.28	.00	2404.
1.01	16.35	199	.28	.24	.03	2412.
1.01	16.40	200	.28	.28	.00	2408.
1.01	16.45	201	.28	.28	.00	2406.
1.01	16.50	202	.28	.28	.00	2405.
1.01	16.55	203	.28	.28	.00	2406.
1.01	17.00	204	.28	.28	.00	2406.
1.01	17.05	205	.28	.22	.00	2321.

1.01	4.40	56	.01	.01	.01	66.	1.01	17.10	207	.02	.02	.00	2133.
1.01	4.45	57	.01	.01	.01	67.	1.01	17.15	207	.02	.02	.00	1997.
1.01	4.50	59	.01	.01	.01	68.	1.01	17.20	209	.02	.02	.00	1939.
1.01	4.55	59	.01	.01	.01	68.	1.01	17.25	209	.02	.02	.00	1912.
1.01	5.00	60	.01	.01	.01	69.	1.01	17.30	210	.02	.02	.00	1900.
1.01	5.05	61	.01	.01	.01	70.	1.01	17.35	211	.02	.02	.00	1894.
1.01	5.10	62	.01	.01	.01	71.	1.01	17.40	212	.02	.02	.00	1892.
1.01	5.15	63	.01	.01	.00	71.	1.01	17.45	213	.02	.02	.00	1891.
1.01	5.20	64	.01	.01	.00	72.	1.01	17.50	214	.02	.02	.00	1891.
1.01	5.25	65	.01	.01	.00	73.	1.01	17.55	215	.02	.02	.00	1891.
1.01	5.30	66	.01	.01	.00	74.	1.01	18.00	216	.02	.02	.00	1891.
1.01	5.35	67	.01	.01	.00	74.	1.01	18.05	217	.02	.02	.00	1813.
1.01	5.40	68	.01	.01	.00	75.	1.01	18.10	218	.02	.02	.00	983.
1.01	5.45	6	.01	.01	.00	75.	1.01	18.15	219	.02	.02	.00	528.
1.01	5.50	70	.01	.01	.0	76.	1.01	18.20	220	.02	.02	.00	333.
1.01	5.55	71	.01	.01	.00	77.	1.01	18.25	221	.02	.02	.00	244.
1.01	6.00	72	.01	.01	.00	77.	1.01	18.30	222	.02	.02	.00	204.
1.01	6.05	73	.07	.05	.02	139.	1.01	18.35	223	.02	.02	.00	185.
1.01	6.10	74	.07	.05	.02	251.	1.01	18.40	224	.02	.02	.00	177.
1.01	6.15	75	.07	.05	.02	341.	1.01	18.45	225	.02	.02	.00	173.
1.01	6.20	76	.07	.05	.02	389.	1.01	18.50	226	.02	.02	.00	172.
1.01	6.25	77	.07	.05	.02	415.	1.01	18.55	227	.02	.02	.00	172.
1.01	6.30	78	.07	.0	.01	429.	1.01	19.00	228	.02	.02	.00	172.
1.01	6.35	79	.07	.05	.01	441.	1.01	19.05	229	.02	.02	.00	172.
1.01	6.40	80	.07	.05	.01	451.	1.01	19.10	230	.02	.02	.00	172.
1.01	6.45	81	.07	.06	.01	459.	1.01	19.15	231	.02	.02	.00	172.
1.01	6.50	82	.07	.06	.01	466.	1.01	19.20	232	.02	.02	.00	172.
1.01	6.55	83	.07	.06	.01	472.	1.01	19.25	233	.02	.02	.00	172.
1.01	7.00	84	.07	.06	.01	477.	1.01	19.30	234	.02	.02	.00	172.
1.01	7.05	85	.07	.06	.01	482.	1.01	19.35	235	.02	.02	.00	172.
1.01	7.10	86	.07	.06	.01	487.	1.01	19.40	236	.02	.02	.00	172.
1.01	7.15	87	.07	.06	.01	492.	1.01	19.45	237	.02	.02	.00	172.
1.01	7.20	88	.07	.06	.01	496.	1.01	19.50	238	.02	.02	.00	172.
1.01	7.25	89	.07	.06	.01	500.	1.01	19.55	239	.02	.02	.00	172.
1.01	7.30	90	.07	.06	.01	503.	1.01	20.00	240	.02	.02	.00	172.
1.01	7.35	91	.07	.06	.01	506.	1.01	20.05	241	.02	.02	.00	172.
1.01	7.40	92	.07	.06	.01	509.	1.01	20.10	242	.02	.02	.00	172.
1.01	7.45	93	.07	.06	.01	512.	1.01	20.15	243	.02	.02	.00	172.
1.01	7.50	94	.07	.06	.01	515.	1.01	20.20	244	.02	.02	.00	172.
1.01	7.55	95	.07	.06	.01	517.	1.01	20.25	245	.02	.02	.00	172.
1.01	8.00	96	.07	.06	.01	520.	1.01	20.30	246	.02	.02	.00	172.
1.01	8.05	97	.07	.06	.01	522.	1.01	20.35	247	.02	.02	.00	172.
1.01	8.10	98	.07	.06	.01	524.	1.01	20.40	248	.02	.02	.00	172.
1.01	8.15	99	.07	.06	.01	526.	1.01	20.45	249	.02	.02	.00	172.
1.01	8.20	100	.07	.06	.01	528.	1.01	20.50	250	.02	.02	.00	172.
1.01	8.25	101	.07	.06	.00	529.	1.01	20.55	251	.02	.02	.00	172.
1.01	8.30	102	.07	.06	.00	531.	1.01	21.00	252	.02	.02	.00	172.
1.01	8.35	103	.07	.06	.00	533.	1.01	21.05	253	.02	.02	.00	172.
1.01	8.40	104	.07	.06	.00	534.	1.01	21.10	254	.02	.02	.00	172.
1.01	8.45	105	.07	.06	.00	535.	1.01	21.15	255	.02	.02	.00	172.
1.01	8.50	106	.07	.06	.00	537.	1.01	21.20	256	.02	.02	.00	172.
1.01	8.55	107	.07	.06	.00	538.	1.01	21.25	257	.02	.02	.00	172.
1.01	9.00	108	.07	.06	.00	539.	1.01	21.30	258	.02	.02	.00	172.
1.01	9.05	109	.07	.06	.00	540.	1.01	21.35	259	.02	.02	.00	172.
1.01	9.10	110	.07	.06	.00	541.	1.01	21.40	260	.02	.02	.00	172.
1.01	9.15	111	.07	.06	.00	542.	1.01	21.45	261	.02	.02	.00	172.
1.01	9.20	112	.07	.06	.00	543.	1.01	21.50	262	.02	.02	.00	172.
1.01	9.25	113	.07	.06	.00	544.	1.01	21.55	263	.02	.02	.00	172.
1.01	9.30	114	.07	.06	.00	545.	1.01	22.00	264	.02	.02	.00	172.
1.01	9.35	115	.07	.06	.00	546.	1.01	22.05	265	.02	.02	.00	172.

1.01	9.40	116	.07	.06	.00	547.	1.01	22.10	266	.02	.02	.00	172.
1.01	9.45	117	.07	.06	.00	547.	1.01	22.15	267	.02	.02	.00	172.
1.01	9.50	118	.07	.06	.00	548.	1.01	22.20	268	.02	.02	.00	172.
1.01	9.55	119	.07	.06	.00	549.	1.01	22.25	269	.02	.02	.00	172.
1.01	10.00	120	.07	.06	.00	550.	1.01	22.30	270	.02	.02	.00	172.
1.01	10.05	121	.07	.06	.00	550.	1.01	22.35	271	.02	.02	.00	172.
1.01	10.10	122	.07	.06	.00	551.	1.01	22.40	272	.02	.02	.00	172.
1.01	10.15	123	.07	.06	.00	551.	1.01	22.45	273	.02	.02	.00	172.
1.01	10.20	124	.07	.06	.00	552.	1.01	22.50	274	.02	.02	.00	172.
1.01	10.25	125	.07	.07	.00	552.	1.01	22.55	275	.02	.02	.00	172.
1.01	10.30	126	.07	.07	.00	553.	1.01	23.00	276	.02	.02	.00	172.
1.01	10.35	127	.07	.07	.00	554.	1.01	23.05	277	.02	.02	.00	172.
1.01	10.40	128	.07	.07	.00	554.	1.01	23.10	278	.02	.02	.00	172.
1.01	10.45	129	.07	.07	.00	555.	1.01	23.15	279	.02	.02	.00	172.
1.01	10.50	130	.07	.07	.00	555.	1.01	23.20	280	.02	.02	.00	172.
1.01	10.55	131	.07	.07	.00	556.	1.01	23.25	281	.02	.02	.00	172.
1.01	11.00	132	.07	.07	.00	556.	1.01	23.30	282	.02	.02	.00	172.
1.01	11.05	133	.07	.07	.00	556.	1.01	23.35	283	.02	.02	.00	172.
1.01	11.10	134	.07	.07	.00	557.	1.01	23.40	284	.02	.02	.00	172.
1.01	11.15	135	.07	.07	.00	557.	1.01	23.45	285	.02	.02	.00	172.
1.01	11.20	136	.07	.07	.00	558.	1.01	23.50	286	.02	.02	.00	172.
1.01	11.25	137	.07	.07	.00	558.	1.01	23.55	287	.02	.02	.00	172.
1.01	11.30	138	.07	.07	.00	559.	1.02	0.00	288	.02	.02	.00	172.
1.01	11.35	139	.07	.07	.00	559.	1.02	.05	289	0.00	0.00	0.00	144.
1.01	11.40	140	.07	.07	.00	559.	1.02	.10	290	0.00	0.00	0.00	81.
1.01	11.45	141	.07	.07	.00	559.	1.02	.15	291	0.00	0.00	0.00	36.
1.01	11.50	142	.07	.07	.00	560.	1.02	.20	292	0.00	0.00	0.00	16.
1.01	11.55	143	.07	.07	.00	560.	1.02	.25	293	0.00	0.00	0.00	7.
1.01	12.00	144	.07	.07	.00	560.	1.02	.30	294	0.00	0.00	0.00	3.
1.01	12.05	145	.07	.07	.00	740.	1.02	.35	295	0.00	0.00	0.00	1.
1.01	12.10	146	.20	.20	.00	1154.	1.02	.40	296	0.00	0.00	0.00	1.
1.01	12.15	147	.20	.20	.00	1452.	1.02	.45	297	0.00	0.00	0.00	0.
1.01	12.20	148	.20	.20	.00	1581.	1.02	.50	298	0.00	0.00	0.00	0.
1.01	12.25	149	.20	.20	.00	1641.	1.02	.55	299	0.00	0.00	0.00	0.
1.01	12.30	150	.20	.20	.00	1669.	1.02	1.00	300	0.00	0.00	0.00	0.
									SUM	31.53	30.37	1.16	258570.
										(801.3)	(771.3)	(29.3)	(7321.89)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13903.	2834.	898.	862.	258557.
CMS	394.	80.	25.	24.	7322.
INCHES		25.96	30.37	30.37	30.37
MM		658.65	771.36	771.36	771.36
AC-FT		1405.	1781.	1781.	1781.
THOUS CU M		1733.	2196.	2196.	2196.

HYDROGRAPH AT ST' 10181 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	2.	4.	7.	9.
12.	14.	17.	19.	22.	24.	26.	28.	30.	32.
34.	36.	38.	39.	41.	42.	44.	46.	47.	48.
50.	51.	52.	54.	55.	56.	57.	58.	59.	60.
61.	62.	64.	64.	65.	66.	67.	68.	68.	69.
70.	71.	71.	72.	73.	74.	74.	75.	75.	76.
77.	77.	130.	250.	341.	386.	413.	429.	441.	451.
459.	466.	473.	477.	483.	487.	492.	496.	502.	503.
506.	509.	512.	514.	517.	520.	522.	524.	526.	528.

529.	531.	533.	534.	536.	537.	538.	539.	540.	541.
543.	543.	549.	545.	546.	547.	547.	548.	549.	550.
553.	551.	551.	552.	553.	533.	554.	554.	555.	555.
556.	556.	556.	557.	557.	558.	558.	558.	559.	559.
559.	560.	560.	560.	744.	1154.	1450.	1581.	1641.	1669.
1682.	1689.	1693.	1695.	1697.	1698.	1700.	1879.	1971.	2010.
2030.	2039.	2045.	2045.	2047.	2048.	2049.	2049.	2134.	2321.
2458.	2516.	2544.	2557.	2563.	2566.	2568.	2568.	2569.	2569.
2466.	2834.	2947.	3153.	3377.	3618.	10686.	13909.	11793.	8419.
6192.	4985.	3699.	3461.	2635.	2525.	2352.	2424.	2412.	2408.
2406.	2405.	2405.	2406.	2321.	2133.	1997.	1939.	1912.	1900.
1894.	1732.	1491.	1991.	1891.	1871.	1617.	968.	528.	333.
244.	204.	187.	177.	172.	172.	172.	172.	172.	172.
172.	172.	172.	172.	172.	172.	172.	172.	172.	172.
172.	172.	172.	172.	172.	172.	172.	172.	172.	172.
172.	172.	172.	172.	172.	172.	172.	172.	172.	172.
172.	172.	172.	172.	172.	172.	172.	172.	172.	172.
172.	172.	172.	172.	172.	172.	172.	172.	172.	172.
172.	172.	172.	172.	172.	172.	172.	172.	144.	81.
36.	16.	7.	3.	1.	1.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13909.	2834.	998.	862.	258557.
CMS	394.	80.	28.	24.	7322.
INCHES		25.96	30.37	30.37	30.37
MM		659.65	771.36	771.36	771.36
AC-FT		1405.	1781.	1781.	1781.
THOUS CU M		1733.	2196.	2196.	2196.

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HYDROGRAPH AT STA 10181 FOR PLAN 1, RTIO 2

1.	3.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	4.	0.	0.	0.	1.	2.	3.	5.
6.	7.	8.	10.	11.	12.	13.	14.	15.	16.
17.	18.	19.	20.	20.	21.	22.	23.	23.	24.
25.	26.	26.	27.	27.	28.	29.	29.	30.	30.
31.	31.	32.	32.	32.	33.	33.	34.	34.	35.
35.	35.	36.	36.	36.	37.	37.	37.	38.	38.
38.	39.	60.	135.	171.	183.	206.	215.	221.	225.
226.	235.	236.	239.	241.	244.	246.	248.	250.	252.
254.	255.	256.	257.	259.	260.	261.	262.	263.	264.
265.	265.	266.	267.	268.	269.	269.	270.	270.	271.
271.	272.	272.	273.	273.	273.	274.	274.	274.	275.
275.	275.	276.	276.	276.	277.	277.	277.	277.	278.
278.	278.	278.	278.	279.	279.	279.	279.	279.	279.
280.	280.	280.	281.	372.	577.	726.	790.	822.	834.
841.	845.	847.	849.	848.	849.	877.	940.	985.	1035.
1014.	1019.	1021.	1023.	1023.	1024.	1024.	1025.	1067.	1161.
1223.	1258.	1272.	1278.	1281.	1282.	1284.	1284.	1284.	1285.
1263.	1147.	1279.	1577.	1988.	3007.	5245.	6954.	5897.	4209.
3196.	2352.	1849.	1558.	1348.	1262.	1226.	1212.	1206.	1204.
1233.	1203.	1203.	1203.	1161.	1057.	998.	969.	956.	950.
947.	946.	945.	945.	945.	945.	805.	491.	264.	167.
132.	102.	93.	88.	86.	86.	86.	86.	86.	86.
86.	86.	86.	86.	86.	86.	86.	86.	86.	86.
86.	86.	86.	86.	86.	86.	86.	86.	86.	86.
86.	86.	86.	86.	86.	86.	86.	86.	86.	86.
86.	86.	86.	86.	86.	86.	86.	86.	86.	86.
86.	86.	86.	86.	86.	86.	86.	86.	86.	86.

86. 18.	86. 8.	86. 4.	86. 2.	86. 1.	86. 0.	86. 0.	86. 3.	72. 1.	41. 0.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6954.	1417.	449.	171.	129379.
CMS	197.	40.	13.	10.	3661.
INCHES		11.06	14.18	15.14	15.14
MM		280.83	385.68	385.68	385.68
AC-FT		705.	893.	890.	820.
THOUS CU M		870.	1100.	1100.	1010.

HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH BROOKFIELD CITY DAM

ITYPE	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	1	0	1	0		1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ICPRST
0			0.031	0.200	0.035	0.000	-1

STAGE	801.00	831.00	833.00	859.00	867.00	895.00	904.00	907.00
FLOW	0.00	311.00	470.00	2479.00	5446.00	5271.00	8166.00	16147.00
CAPACITY=	0.	247.	531.	1890.	3539.	5147.		
ELEVATION	765.	780.	795.	800.	805.	820.		

QREL	SPVOL	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
900.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
905.0	0.0	0.0	0.

STATION , PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	2.	2.	3.	3.	3.	4.
4.	5.	5.	5.	6.	7.	7.	8.	8.	9.
10.	11.	11.	12.	12.	13.	14.	15.	15.	16.
17.	18.	19.	19.	20.	21.	21.	22.	23.	24.
24.	25.	26.	27.	27.	28.	29.	30.	30.	31.
32.	33.	34.	36.	41.	46.	52.	58.	54.	70.
77.	83.	89.	96.	102.	108.	114.	121.	127.	133.
139.	145.	151.	157.	163.	169.	175.	180.	186.	192.

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SUMMARY OF PMF AND ONE-HALF PMF FLOOD ROUTING

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00	RATIO 2 .50
HYDROGRAPH AT	1614	1.10 (2.85)	1	13904. (393.8)	6954. (196.9)
ROUTED TO		1.10 (2.85)	1	9546. (270.3)	4773. (135.1)

RATIOS APPLIED TO FLOWS

B-23

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... ELEVATION / STORAGE / OUTFLOW — INITIAL VALUE: 800.00 / 1992. / 0. — SPILLWAY CREST: 830.0 / 1992. / 0. — TOP OF DAM: 835.30 / 2533. / 3446.

RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	[illegible]	.50	3591.	4568.	.75	16.00	0.00
.50	[illegible]	0.00	2248.	1723.	0.00	16.00	0.00

PERCENT OF PMF FLOOD ROUTING
EQUAL TO SPILLWAY CAPACITY

PRINTOUT OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 10101
ROUTE HYDROGRAPH TO
END OF NETWORK

AD-A104 613 CONSOER TOWNSEND AND ASSOCIATES LTD ST LOUIS MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. BROOKFIELD CITY DAM (MO 10181), GR--ETC(U)
DEC 79 W G SHIFRIN DACW43-79-C-0075
UNCLASSIFIED NL

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 79/08/28.
     TIME= 07.31.48.
```

DAM SAFETY INSPECTION - MISSOURI
BROOKFIELD CITY DAM (MO.10101)
PERCENT PMF

JOB SPECIFICATION

IT	IPRT	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	5	0		0	0	0	4	0

JOPER	NO	LROPT	TRACE
			0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLANS= 1 NRTIOS= 6 LRTIOS= 1

RTIOS= .75 .86 .97 .98 .99 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10101	2	0	0	0	0	0	0	

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	1.10	0.00	1.10	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.25	110.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-91.00	0.00	0.00

CURVE NO = -91.00 WETNESS = -1.00 EFFECT CN = -91.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .13

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

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SUM 31.53 30.37 1.16 258570.
(801.11 771.11 29.11 7321.89)

HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH BROOKFIELD CITY DAM

ITAW	ICOMP	ICON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	1	0	0	0	0	0	3	0

ROUTING DATA

SLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.100	0.0	1	1	0	0	3

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
2	0	0	0.000	0.000	0.000	-900.	-1

ELEV	800.00	801.00	802.00	804.00	805.00	805.50	806.00	807.00
FLOW	0.00	311.00	473.00	2475.00	3446.00	5274.00	8166.00	16147.00
CAPACITY=	0.	285.	531.	1591.	2539.	5147.		
ELEVATION=	765.	795.	795.	800.	805.	820.		

CPEL	SPAN	COOL	EXPL	ELEVL	COOL	CAREA	EXPL
808.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
808.0	0.0	0.0	0.

PEAK OUTFLOW IS 3243. AT TIME 15.00 HOURS

PEAK OUTFLOW IS 3248. AT TIME 14.08 HOURS

PEAK OUTFLOW IS 3332. AT TIME 16.08 HOURS

PEAK OUTFLOW IS 3379. AT TIME 14.08 HOURS

PEAK OUTFLOW IS 3424. AT TIME 15.08 HOURS

PEAK OUTFLOW IS 3509. AT TIME 16.08 HOURS

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS					
				RATIO 1 .85	RATIO 2 .86	RATIO 3 .87	RATIO 4 .88	RATIO 5 .89	RATIO 6 .90
HYDROGRAPH AT	10101	1.10	1	11822.	11951.	12081.	12240.	12379.	12518.
		(2.85)		(334.777)(	338.713)(	342.393)(	346.879)(	350.813)(	354.747)(
ROUTED TO		1.10	1	3243.	3284.	3325.	3370.	3410.	3450.
		(2.85)		(91.844)(	93.006)(	94.168)(	95.439)(	96.601)(	97.733)(

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	800.00	800.00	805.00
STORAGE	[illegible]	1893.	2539.
OUTFLOW	0.	0.	3446.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV.	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	[illegible]	0.00	2512.	3243.	0.00	16.08	0.00
.06	[illegible]	[illegible]	2518.	3288.	0.00	16.08	0.00
.07	[illegible]	[illegible]	2524.	3333.	0.00	16.08	0.00
.08	804.73	0.00	2530.	3379.	0.00	16.08	0.00
.09	[illegible]	0.00	2536.	3424.	0.00	16.08	0.00
.10	805.00	.00	2542.	3509.	.17	16.08	0.00

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